BEFORE THE NATIONAL GREEN TRIBUNAL

WESTERN ZONE BENCH, PUNE

AT PUNE

ORIGINAL APPLICATION NO.74/2024(WZ)

BHAVESH ARUN KAREKAR & ANR. **APPLICANTS**

V/s

MoEF&CC & ORS. **RESPONDENTS**

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PUNE

DATE : 23/08/2024

Advocate for Respondent No.5

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AT PUNE

ORIGINAL APPLICATION NO.74/2024(WZ)

BHAVESH ARUN KAREKAR & ANR. **APPLICANTS**

V/s

MoEF&CC & ORS. **RESPONDENTS**

REPLY ON BEHALF OF RESPONDENT No.5

(M/s.ASHAPURA MINECHEM LIMITED)

MAY IT PLEASE THE HON'BLE TRIBUNAL

Reply on behalf of abovenamed Respondent No.5 is as under: -

1. At the outset, the Respondent No.5 does not admit what is stated in the Original Application filed by the Applicant except what forms part of the record and denies everything in the said application that is contrary to what is stated and/or inconsistent herein .
2. The Respondent No.5 submits that nothing, not expressly admitted, herein ought to be taken as admitted by the Respondent No.5 or be deemed to have been admitted by Respondent No.5 for want of specific traverse. The Respondent No.5 states that for the purpose of brevity, the Respondent No.5 is not denying each and every allegation, statement or contention of the Applicant which is ex-facie contrary to the Respondent No.5's contentions and its stand in

the present case except to the extent that such allegations, statements or contentions necessitate comment or warrant a reply.

3. The Respondent No.5 submits that the Bauxite mining lease at village Rowale is executed on 14/02/2005 and the land acquisition process and exploration activity started in July 2005. After obtaining first Environmental Clearance on 29/12/2006 and Consent To Operate on 07/02/2007 for 60,000 TPA, the mining work started in small scale whereas the first dispatch from this mine happened in September 2008. Thereafter, the EC for this mine was enhanced to 2,50,000 TPA on 31/10/2008 which was subsequently enhanced to 8,00,000 TPA on 24/02/2016. The Consent To Operate granted by the Respondent No.3 has been renewed on timely basis. The statutory authorities are already performing their statutory duties. The Respondent No.5 submits the 6 monthly compliance reports to the Respondent No.1 in accordance with the EC granted to it. Till date, no non-compliance has been reported by any of the bodies against the Respondent No.5, as it has been scrupulously complying with the terms and conditions in respect of the permissions granted to it.

(I) PRELIMINARY OBJECTIONS TO THE ORIGINAL APPLICATION

4. The Respondent No.5 submits that no substantial issue relating to the environment under Section 2(m) of the NGT Act, 2010 has been made out for adjudication of this Hon’ble Tribunal. The Respondent No.5 further submits that the Applicants herein have no locus to file

the present application and it is also not an aggrieved party to the present proceedings. The Hon'ble Supreme Court has held that the bonafides of the litigant are to be tested before proceeding with the proceedings for adjudication. The Hon'ble Supreme Court in the judgment of Uday Welfare Trust has held that "*We find that before a litigant is permitted to knock the doors of justice and seek orders which have far reaching effects of affecting the employment of thousands of persons, stopping investment in the State, prejudicing the interests of the farmers the credentials and bonafides of the Respondent No.5s must be tested. In the present case, there is scope to infer that the litigation could be at the behest of the existing WBIs who wanted to avoid competition and continue to get raw material at a cheaper rate. There is also scope to infer that it could be at the behest of the WBIs in the adjoining Yamuna Nagar district of Haryana where lakhs of tons of timber is exported from the State of Uttar Pradesh. There is scope to infer that it could be in the interest of middlemen who are engaged in exporting timber from Uttar Pradesh to Haryana. We would, therefore, only request the learned NGT that, when credentials and bonafides of such litigants are seriously raised and when entertaining the grievance of such litigants, which is likely to adversely affect the rights of many, it should ensure the bonafides and credentials of such litigants*." The Respondent No.5 submits that the Applicant No.1 resides at a distance of 180 kms from the mining area. The Applicant No.1 has merely stated that he is founder and director of some charitable trust. However no evidence is produced on record and only a statement has been made without any evidence on record. The description of

the Applicant No.2 is also made without producing any document on record. The Applicant No.2 bought the land in village Rowale at Survey No.18 somewhere in April 2012 and some other land within the mining lease in January 2014 and started living there from somewhere in 2016 when the mining and transport of the Respondent No.5 was in operation and that this survey number is part of mining lease was well known to the Applicant No.2. Hence, the statement of the Applicant No.2 that *'she has chosen this place which was really untouched & had lots of rarest bird species'* may not hold any ground. It clearly appears that the Applicants are trying to ensure that the activities of the Respondent No.5 are hampered for their personal gains and are also indulging the activities of instigating the other villagers. Hence, the present Application be dismissed on this ground alone.

(II) <u>PARA-WISE REPLY TO THE ORIGINAL APPLICATION</u>

5. The Respondent No.5 submits that with respect to the contents of paras 1 to 3 of the Original Application, the same do not require any comment.
6. The Respondent No.5 submits that with respect to the contents of para 4 of the Original Application, the Respondent No.5 submits that that the statement therein is vague and baseless. The Applicant has failed to substantiate that what exactly is the substantial question relating to the environment under the provisions of section 2(m) of the NGT Act, 2010. The mere state of *non-compliance of environmental laws* also does not justify any sort of illegal activities

on the part of the Respondent No.5. In fact as stated earlier, the Respondent No.5 has been scrupulously following the conditions of the Environmental Clearance and that of the Consent to Operate granted by the Respondent Nos.1 & 3 respectively.

7. The Respondent No.5 submits that with respect to the contents of paras 5 & 6 of the Original Application, the Respondent No.5 has already pointed out that the Applicants are not the aggrieved parties and have no locus to file the present Original Application.
8. The Respondent No.5 submits that with respect to the contents of para 7 of the Original Application, the same is repetition of earlier statements and also that it is vague and does not state the cause of action to file the present application.
9. The Respondent No.5 submits that with respect to the contents of para 8 of the Original Application, the core mining activity is far away from the human habitat, to be precise it is beyond 500M from the nearest household. The statement '*Many accidents have occurred…*'is more generalised as till date not even a single reported loss of life and or permanent disability to any human being is reported due to mining activity of the Respondent No.5 or attributed to allied activities. The representation by the villagers to the Applicant is a part of targeted propaganda against the Respondent No.5 without highlighting the exact nature of problems faced by them and attributed to mining and allied activity of the company. As per the information available in public domain, the population of Dapoli Taluka is 1,62,627 and of Mandangad Taluka is 62,123 (as per 2011 census) and as stated in the villager's representation, the total affected are 196 people and out of them 13 were residents of

Mandivali Bazarpeth and rest 183 were of Mandangad taluka whereas core mining activity is done in Rowale village of Dapoli taluka. These villagers who made representations to the Applicants form about 0.09% of the total population of Dapoli and Mandangad Taluka and none of them own any land in mining lease area, as has been verified by the Respondent No.5 and it is not clear how they are alleging about these problems such as heavy air, noise and water pollution in Rowale village and degradation of the land owned by these 196 people. Locus-standi may be properly examined in respect of the people mentioned in the representation. Furthermore, it is submitted that the Environmental Clearance was granted to the Respondent No.5 after conducting the Public Hearing. It is worthwhile to mention that the EC has been granted to the Respondent No.5 on 24.02.2016 and that the so called villagers seem to be surprisingly aware of the alleged activities of the Respondent No.5 in 2024. Thus, it is clearly seen that the Applicants have indulged in the activity of instigating the villagers and obtaining their signatures just to create a false picture before this Hon'ble Tribunal that they are suffering on account of the alleged activities of the Respondent No.5.

10. The Respondent No.5 submits that with respect to the contents of paras 9 & 10 of the Original Application, the contents therein are a matter of record and hence need not be commented by the Respondent No.5. The Respondent No.5 submits that the EC was granted for 8 LTPA in last 5 financial years. The Respondent No.5 has produced 2,39,035 tonnes of ROM which gives yearly average of 47,807 TPA and dispatched 3,30,693.08 tonnes of bauxite which

gives yearly average of 66,139 TPA. Hence, the ROM production in last 5 financial years is mere 6% of the EC capacity and dispatch is about 8%. The year wise data is given below.

Year	ROM production	Dispatch
2019-2020	1,22,035	75,287.52
2020-2021	0	0
2021-2022	0	47.06
2022-2023	45,000	1,72,031.69
2023-2024	72,000	83,326.81
Total	2,39,035	3,30,693.08

From the aforesaid data, it is clear that the Respondent No.5 are far below the total EC capacity. The Respondent No.5 states and submits that all the conditions prescribed by EC and CTO are complied with. Copy of the latest six monthly report as submitted to the Respondent No.1 is annexed hereto and marked as **ANNEXURE –R-1**.

11. The Respondent No.5 submits that with respect to the contents of para 11 of the Original Application, the same are vague and generalised in nature and hence warrant no comment. However as stated earlier, all the conditions prescribed by EC and CTO are complied with.

12. The Respondent No.5 submits that with respect to the contents of para 12 of the Original Application, the contents therein are not admitted by the Respondent No.5. The complaint of the Applicants was never handed over to the Respondent No.5. Hence, the Respondent No.5 is not aware of the contents of the same.

13. The Respondent No.5 submits that with respect to the contents of para 13 of the Original Application, the contents therein are not

admitted by the Respondent No.5. It is submitted that the observations recorded in the said visit note are beyond the scope and purview of the Respondent No.3. The Respondent No.3 has recorded the observations, which are not part of the Consent Conditions and hence the said visit note is required to be discarded by this Hon'ble Tribunal.

14. The Respondent No.5 submits that with respect to the contents of para 14 of the Original Application, the contents therein are not admitted by the Respondent No.5

15. It is also worthwhile to mention herein the conduct of the Respondent No.3. The Respondent No.5 was in receipt of the warning notice dt. 21.11.2023 from the Respondent No.3. The Respondent No.5 has filed its detailed response dt. 25.11.2023 to the same. Copy of the reply to the warning notice is annexed hereto and marked as **ANNEXURE – R-2**. The Respondent No.5 submits that the Respondent No.5 never received the show cause notice dated 02.01.2024 and hence the same was never responded to. The Respondent No.3 is called upon to produce the proof of service of the said show cause notice dt. 02.01.2024 upon the Respondent No.5.

16. The Respondent No.5 submits that with respect to the contents of para 15 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Respondent No.5 has received the Proposed Directions dated 25/04/2024 and the same has been responded by the Respondent No.5 vide its detailed reply dated 30/04/2024. Copy of the reply dated 30/04/2024 is annexed hereto and marked as **ANNEXURE – R-3**. However, it is pertinent to note

that the aforesaid proposed directions were issued to the Respondent No. 5 by the Respondent No.3 without serving the said show cause notice dated 02.01.2024 and consequently without receiving any response thereto.

17. The Respondent No.5 submits that the Hon'ble Tribunal should take a note of the conduct of the Applicants. The Respondent No.5 has also mining operations at Village Umbershet. The present Applicants have filed a case before this Hon'ble Tribunal being Original Application No.165 of 2024 in respect of Umbershet mines. The contents of the said Original Application are identical to the present Original Application. The Respondent No.3 has filed an affidavit in the said case. The contents and the dates of the visit note, the warning notice, the show cause notice and the proposed directions are also identical. Copy of the Affidavit filed by the Respondent No.3 in OA No.165 of 2024 is annexed hereto and marked as **ANNEXURE – R-4**.

18. The Respondent No.5 submits that with respect to the contents of para 16 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Respondent No.5 submits that the Respondent No.5 has been scrupulously following the conditions mentioned in the Environmental Clearance. The Respondent No.5 has already produced before this Hon'ble Tribunal the last 6 monthly compliance report. The Respondent No.5 craves leave to refer to and rely upon the earlier reports at the time of the hearing and if need be, will be produced before this Hon'ble Tribunal. The study that the applicant has alleged about is not mandatory.

19. The Respondent No.5 submits that with respect to the contents of para 17 of the Original Application, the contents therein are not admitted by the Respondent No.5. The statements made in this para are without any evidence or documentary proof. The mining activity is carried out using rock breakers, considering the nature of non-continuous pocket deposit and no blasting is being done at the site. Thus, the statements made by the Applicant are false and baseless. The visit report produced by the Applicant at Annexure – L also mentions the said fact.

20. The Respondent No.5 submits that with respect to the contents of para 18 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Air Pollution Control system is in place and the same has been verified time and again by the Respondent No.3 and hence the Consent to Operate is renewed time and again. The transport activity is carried out properly and each truck is issued with a transit pass generated online through the website of Maharashtra DGM ILMS. The generation of transit pass is fully secure atmosphere with DSC and weight of the cargo is auto captured without any manual intervention. The said record is available online for verification.

21. The Respondent No.5 submits that with respect to the contents of para 19 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Respondent No.5 states that the mining and allied activities are never done during the night as stated and it is a false submission by the Applicant No.2.

22. The Respondent No.5 submits that with respect to the contents of para 20 of the Original Application, the contents therein are not

admitted by the Respondent No.5. The Applicant has already stated that they are not carrying out any blasting work at the site. The mining is being done using rock breakers. The averments made in the said para is the figment of imagination of the Applicants. No evidence or documentary proof is submitted to support the statements.

23. The Respondent No.5 submits that with respect to the contents of para 21 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Respondent No.5 submits that only one out of the 5 slips at Annexure H is bearing the name of Respondent No.5 that too of the year 2017 is produced as evidence of overloading. The trucks are loaded as per their carrying capacity by the Respondent No.5 and annexed hereto is the photo of the latest slip issued by Respondent No.5 and marked as **ANNEXURE – R-5**. The Applicants have acted in arbitrary manner to stop a truck for inspection which was loaded as per its carrying capacity as it was a 4 axel 16 tyre big capacity heavy goods truck which is allowed to carry large weight as can be seen from the photograph produced on record. The truck was not at all overloaded and it was properly covered with tarpaulin to prevent air pollution during the transport. The entire case of the Applicants is based on surmises and conjectures without any supporting evidence.

24. The Respondent No.5 submits that with respect to the contents of para 22 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Applicants have not taken the pain to do research before filing of this Application as the allegation

would not have been made if the 6 monthly compliance report would have had been studied. The allegations are being made only for the sake of it without any solid proof thereof.

25. The Respondent No.5 submits that with respect to the contents of para 23 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Respondent No.5 submits that the Google imagery in Annexure I can't be construed as tool to identify afforestation and the Respondent No.5 has carried out afforestation as per the statutory norms. Reclamation and rehabilitation are being carried out in scientific manner as prescribed by the statutory agencies.

26. The Respondent No.5 submits that with respect to the contents of para 24 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Respondent No.5 uses certain public roads available in the area for carrying out its transport and these are already black topped roads per se. In mines the haulage roads are purely of temporary nature and are properly wetted to avoid air pollution and no general public are allowed/do not use these roads for their day-to-day purpose. The Annexure-J relied upon by the Applicant does not prove anything as alleged by the Applicant. No violation to EC and CTO conditions are done by the Respondent No.5. All mining activities are carried out in compliance with approved Mining Plan. It is a baseless allegation that dust from mining and transport activity are causing breathing and other health related problems to the people residing at the far away villages. The Respondent No.5 submits that in the year 2016, similar allegations were made by one Mr. Halde and the Kelshi Public Health Centre

which caters for the needs of the people in buffer zone area of mine had stated that there are no such health issues found in the residents. The Respondent No.5 craves leave to refer to and rely upon the said reply at the time of hearing.

27. The Respondent No.5 submits that with respect to the contents of para 25 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Applicants in the garb of the present Original Application are trying to challenge the Environmental Clearance granted in 2016 after following due process of law. It is not permissible in law. The EIA and EMP for Rowale Bauxite mines are prepared after public hearing for enhancement in the year 2015 after duly considering the issues raised by the participants during the hearing.

28. The Respondent No.5 submits that with respect to the contents of para 26 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Respondent No.5 submits that the back filled area inside the mining lease is planted with fruit bearing local species like Cashew saplings and till date about 9.22 Ha is covered with cashew plantation and they are yielding to their fullest capacity now and have become good source of income to the landowners. It pertinent to note that if the plants inside the mining area do not suffer from any impact of mining, how the other crops which are away from the mine site can be affected. The mining activity is carried out in barren, uncultivable land, and no abnormal impact on agriculture productivity due to mining is observed.

29. The Respondent No.5 submits that with respect to the contents of para 27 of the Original Application, the contents therein are not

admitted by the Respondent No.5. The Respondent No.5 submits that considering the meagre quantum of transportation activities carried on by the Respondent No. 5 from its mine, resorting to such unregulated transport is inconceivable.

30. The Respondent No.5 submits that with respect to the contents of para 28 of the Original Application, the contents therein are not admitted by the Respondent No.5. The said allegations are a repetition of the allegations made earlier. The Respondent has replied to all notices received from the statutory authorities. The allegation of the Applicants in the said para in fact is contrary to the Show Cause notice at Annexure L. The said Show Cause notice does not point out any violation on the part of the Respondent No.5.

31. The Respondent No.5 submits that with respect to the contents of para 29 of the Original Application, the contents therein are not admitted by the Respondent No.5. The allegations are a repetition and hence already have been responded by the Respondent No.5.

32. The Respondent No.5 submits that with respect to the contents of para 30 of the Original Application, the contents therein are not admitted by the Respondent No.5. The Respondent No.5 states that the photos attached by the Applicant do not point out the violation of EC conditions. In fact, the Respondent No.5 doubts the authenticity of the same. Moreover, in these photos it can be observed that whatever dust generated is suppressed at source by water spraying and no dust is being generated at the heart of mining activity and proper drains, water channels, retaining walls are made by the Respondent No.5 to prevent any environment pollution. The Respondent No. 5 produces few copies of the current photos of the

trench to prove that it maintains the mining area properly. Copies of the said photographs are annexed hereto and marked as **ANNEXURE – R-6 (COLLY)**

(III) REPLY TO THE AFFIDAVIT OF RESPONDENT No.3 DATED 1ST JULY 2024

33. The Respondent No.3 has filed the copy of the Show Cause notice dated 02.01.2024. The Respondent No.5 submits that the said show cause notice was never received by the Respondent No.5. The violations mentioned in the said show cause notice, infact do not fall within the purview of the Respondent No.3.

34. The Respondent No.5 submits that the Respondent No.3 had sent the proposed direction to the Respondent No.5 on 25.04.2024. The same has been duly responded to by the Respondent No.5. Copy of the same is already produced on record.

35. The Respondent No. 5 states that the contentions of the said Affidavit of the Respondent No. 3, have already been dealt with by the Respondent No. 5 in the aforementioned paragraphs of this Reply.

(IV) OBJECTIONS TO THE JOINT-COMMITTEE REPORT DATED 12.08.2024 :

36. The Respondent No.5 submits that the present application was listed before the Hon'ble Bench on 15.04.2024 for the first time and while issuing the notice to the Respondents, the Hon'ble Tribunal also ordered constitution of a joint committee comprising representatives of Ministry of Environment and Forest, Central Pollution Control Board, Central Groundwater Board and The Collector. This committee was directed to visit the site and submit a factual and action taken report with regard to the violation if any, action taken thereon. The Respondent No.5 submits that while considering the application for the first time, there was no notice to Respondent No.5, nor Respondent No.5 was served with copy of said application as an advance copy. The Respondent No.5 would therefore, submit that this order of the Hon'ble Tribunal was passed without the notice or appearance of Respondent No.5. The Respondent No.5 would like to submit that under the provisions of the National Green Tribunal Act, 2010, section 19, it was necessary that the Respondent No.5 should have been served the application and duly heard in the matter before issuance of any such order by the Hon'ble Tribunal. Therefore, the Respondent No.5 submits that the said order dated 15.04.2024, constituting the joint committee, needs to be recalled based on principles of natural justice as required under Section 19 of NGT Act, 2010. The Hon'ble Supreme Court in the case of Ankita Sinha has also held that the Hon'ble NGT has to follow the

principles of natural justice as enshrined in Section 19 of the NGT Act.

37. The Respondent No.5 further submits that the representatives included in the committee are also party Respondents in the present case. Despite them being the parties to the present proceeding, their representatives have been included as members and overall co-ordinators of the joint committee which is not in the compliance of legal maxim that you cannot be the judge of your own case (*Nemo judex in causa sua*). The Respondent No.5 therefore submits that the constitution of such expert committee is against the principles of law and natural justice. Respondent No.5 further submits that though Respondent No.5 does not have any questions on qualifications or competence of the concerned officers, the Respondent authorities have granted the permissions to the Respondent No.5 and also have been monitoring the compliance of the Respondent No.5, their presence in the Committee itself brings conflict in functioning of the committee. The constitution of the committee and the report thereof cannot be therefore considered as unbiased and cannot be relied in totality and hence the same is required to be discarded.

38. The Applicant has not made out any case relating to substantial question relating to the environment, nor has produced any documentary proofs. The only intention of the Applicant was to file the present case and indulge in fishing and rowing enquiry. The Committee members have prepared the reports without considering the factual position, which gives material to the Applicants to go and address the press reporters and publish articles tarnishing the image of the Respondent No.5. The Hon’ble Tribunal has to take a serious

view regarding this and not appoint committees blindly by giving an opportunity to the litigants to take this Hon'ble Tribunal for a ride. The Applicant has already released the report in the press and is tarnishing the image of the Respondent No.5. Copy of the newspaper article is annexed hereto and marked as **ANNEXURE – R-7**. The Applicant has also circulated a message to villagers that if they will support then they will get Rs. 2 crores from penalty. Copy of the screenshot of the message alongwith its Translation circulated by the Applicant No.1 is annexed hereto and marked **ANNEXURE – R-8**. The report has been prepared without verifying the record and the observations made in the report reflect total ignorance of factual position. The officers who have caused the visit have ignored the basic principles of verification of record while preparing the report and thus have caused serious prejudice to the Respondent No.5. The report is thus required to be discarded in totality.

39. The Respondent No.5 submits that the Committee has continuously used the word "lease" in the report and more specifically in para 4.5. The representatives of the Respondent No.5 have during the visit, informed that currently the Respondent No.5 holds surface right for 59.93 Ha by way of agreements and surface right for remaining area is still to be obtained. The word *lease* gives different context. The right terminology is that the Respondent No.5 only has the ***surface rights.*** Copy of an agreement with one of the land owners is annexed hereto and marked as **ANNEXURE – R-9.**

40. The Respondent No.5 submits that the Committee has stated that the Respondent No.5 has installed moveable crushers of 250 TPH capacity. The Respondent No.5 submits that wordings

installed/established are used to give an impression of standalone processing unit. The Respondent No.5 during the inspection informed the Committee that the Respondent No.5 uses mobile crushers which are crawler mounted and they fall under the category of "Heavy Earthmoving Machinery". The Respondent No.5 practices in pit crushing and it is allied activity of mining and hence no separate consent is required to be obtained from the Respondent No.3. The machines are rented from a contractor. Copies of the photographs of the said machines are annexed hereto and marked as **ANNEXURE – R-10**. The Respondent No. 5 states that the committee has failed to appreciate that the crushing activity in the mines is allowed in the EC dated 24th February, 2016. A relevant extract of the Point No. 4 of the said EC is reproduced herein "

Point no.4: "……loosened ore will be excavated and loaded into the tipper by Hydraulic excavator. Tipper will transport the ore to the processing plant. Ore will be crushed here……"

A copy of the said EC dated 24th February, 2016 is annexed hereto as **ANNEXURE – R-11.**

41. The Respondent No.5 submits that the Committee has stated in para 5.1.5, that there is not CCTV surveillance. The mining activity is carried out by opencast method of mining in vast area at different parts of the mining lease. CCTV surveillance for opencast mining is unheard of. The Respondent No.5 is allowed to work from sunrise to sunset at its mines by Director General of Mines Safety and that the Respondent No.5 has never violated the conditions. Moreover,

no violation in this regard is reported by Director General of Mines Safety till date.

42. The Respondent No.5 submits that the Committee in para 5.1.6 has stated that the PP has not obtained Consent for stone crushers. As stated earlier, the Respondent No.5 during the inspection had informed the Committee that the Respondent No.5 uses mobile crushers which are crawler mounted and they fall under the category of Heavy Earthmoving Machinery. The Respondent No.5 practices in pit crushing and it is allied activity of mining and hence no separate consent is required to be obtained Respondent No.3. If these crushers were standalone units and are fixed crushing units, then the issue of separate Consent would have arisen. It is pertinent here to mention that the CTO issued by MPCB dated 26/11/2019 to the Respondent No. 5 which was valid till 30/04/2021 clearly mentioned under the head 'Product/Activity' as 'Mining of bauxite ore including mobile crushing and Screening activity'. However, in subsequent renewals, the aforesaid activity is now described or worded as *Consent is valid for the manufacture of Bauxite Ore*… The word *manufacture* is wide enough to conclude that the movable crushers are covered in current CTO. Copies of the CTO dated 26/11/2019 and the recent CTO are annexed hereto and marked as **ANNEXURE – R-12 colly**.

43. The Respondent No.5 submits that with respect to observation by the Committee in para 5.2.3, the committee without verification just assumes that the residence of the Applicant is impacted. The assumption is baseless. It is pertinent to note that mining and allied activity of the Respondent No.5 in this region is in progress since

2006. The Applicant No.2 who was originally a resident of Mumbai came here and purchased the land in 2012 and she built her residence in 2014, and this land was already part of the mining lease. Therefore, the Applicant No.2 was very much aware about the mining and allied activity. The mala fide intentions of the Applicants is clearly to harass and exploit the Respondent No.5. The Respondent No.5 submits another complainant had also made a failed attempt in the same manner in 2016 by filing Original Application No.74 of 2016. Copy of the final judgment in OA NO.74 of 2016 is annexed hereto and marked as **ANNEXURE – R-13**.

44. The Respondent No.5 submits that with regard to the observations in para 5.3, the same are based without verifying the records. During inspection, the Respondent No.5 informed that the average water consumption is around $80m^3$/day. The said fact is also mentioned in the CTO. The Respondent No.5 is not aware why it is mentioned $120m^3$/day by the Committee and attributed the same to the Respondent No.5. The same is false. During the inspection, the Respondent No.5 informed the Committee that the flow meter was taken for maintenance as the mining season has ended and word *defunct* will give different context. The observation in para 5.3.3 is totally erroneous and made without considering factual position. During the inspection, it was informed to the Committee that the NOC granted by the CGWA expired on 07/12/2023 and application for renewal is made and is in process at CGWA as on date. Copy of the earlier NOC granted by the CGWA is annexed hereto and marked as **ANNEXURE – R-14** and the screenshot showing the application status is annexed hereto and marked as **ANNEXURE – R-15**.

45. The Respondent No.5 submits that the observations made in para 5.5.3 and 5.5.4 are totally false. The committee failed **to** assess the issue in technical manner. During the inspection it was informed to them the Respondent No.5 had planted cashew saplings over the mined out back filled area which are *native species*. Copies of the few latest photographs showing Cashew plantation are annexed hereto and marked as **ANNEXURE – R-16 (COLLY).** The Respondent No.5 practices Ultra-High-Density/high density plantation of cashew saplings as advised in various scientific studies conducted and published by Indian Council of Agriculture Research wherein it is stated that in case of high density and ultra-high-density plantation is done the cashew saplings of about 625 and 1600 shall be planted respectively and this is normally practiced where the soil is less fertile. In the present case an area of 9.26Ha plantation is done by cashew saplings numbering 19,098. This makes about 2,062 saplings per hectare and if it is considered the survival rate of about 80%, it comes down to about 1,649 plants per hectare. The backfilling and plantation programme of the Respondent No.5 is in line with the approved progressive mine closure plan by IBM and no violation in this regard is reported by IBM till date. Moreover, as per Rule 27 of MCDR 2017 as amended up to date, for due and proper implementation PMCP, the Lease Holder is required to furnish financial assurance in the form of BG at the rate of Rs. 5 Lakh per Ha and for this mine the Respondent No.5 has submitted BG amounting to Rs.3,17,92,500/- to IBM. Copy of the studies mentioned above is annexed hereto and marked as **ANNEXURE – R-17 colly** and the BG submitted is annexed hereto and marked

as **ANNEXURE – R-18**. Without taking into consideration the technical aspects of the cashew plantation, the committee concluded that the Respondent No.5 is in violation of the EC regarding tree plantation. That too despite observing that approximately 5 -7 feet are available at the site and is contradictory.

46. The Respondent No.5 submits that the observations in para 5.6 is beyond the scope of the Committee and not within the purview of this Hon'ble Tribunal as the same is not an environmental issue. The said road is a district road bearing No. MDR- 4 . The poor condition of the road cannot only be attributed to the Respondent No.5 as there are numerous other vehicles plying on the said road like State Transportation and Private buses with passengers, as well as trucks carrying construction material like cement, steel etc.

47. The Respondent No.5 submits that the observations in para 6 is totally without considering the factual position under law. The Respondent No.5 is granted and executed a mining lease over an area of 218.285Ha by State/Central Government for bauxite mining. The Respondent No.5 has obtained surface rights for 59.93Ha from landowners by way of agreement in which mining of bauxite is done, after that the land is backfilled using the Overburden and intercalated waste and mineral rejects, and after that the cashew plantation is carried out and the land is returned to the landowner. The actual residential area is nearly about a kilometre away from the mine with an exception to house of the Applicant No.2 which is about 550M. There are no other dwellings in the vicinity. Hence, committee's observation that mining activities are directly impacting the residents does not hold any ground and is an improper observation

made without considering the situation on ground. There is no supporting evidence produced on record by the Applicant or also by the Committee. Copy of the google image is annexed hereto and marked as **ANNEUXRE – R-19**.

48. The Respondent No.5 submits that the committee despite of documentary evidence provided by the Respondent No.5 during the site visit specifically the monitoring reports which are the essential basis for deciding upon the pollution and shows that all the results are well within the prescribed limits, falsely implicated the Respondent No.5. Despite of the proper and just clarification about cashew plantation, PMCP, Approved Mining Plan, back filling and plantation and its own observation during the site visit, the Committee held the Respondent No.5 to be non-compliant to EC condition of tree plantation. The said observation is thus unjust. The non-compliance pointed out by the committee with regards to operating crushers without consent from Respondent No.3 is also an incorrect one and needs to be countered strongly. It is no violation as the same are movable heavy machines and the same has also been accepted by the Respondent No.3.

49. The Respondent No.5 submits that in the absence of any violation, this part in para 7.1.4 is irrelevant and unjust. The committee erred in calculation in deciding the *S* Factor for scale of operation. Even though the Respondent No.5 had the EC for production of 8,00,000 tonnes bauxite per annum, which makes 40,00,000 tonnes cumulatively for EDC duration, the Respondent No.5 produced only

2,39,035 tonnes during the EDC duration which makes to just 6% of permitted quantity. That too this production was done over 582 days thus making the per day production of about 411 tonnes of bauxite. The Committee erred in concluding it to be a “Large Scale”.

50. The Respondent No.5 submits that the committee made grave error in imposing EDC for ground water. The Respondent No.5 was in possession of the CGWA NOC for this project and EDC for ground water is wrongly enforced on the Respondent No.5 despite providing the proper documents during the inspection such as Water Quality Monitoring Report, Water Consumption Report and Well-water level Monitoring Report As per CGWA NOC, the Respondent No. 5 is allowed to use 120 cubic meter against EC capacity of 8 lacs MT per year or 40 lacs MT in FIVE years, but in last 5 years, the Respondent No. 5 has carried out production of 2,39,035 MT only. Therefore, the observations of considering water consumption of 120 cub meter by the Committee is erroneous. It is also pertinent to note that, the average water consumption is also wrongly quoted by the committee as $120M^3$ per day instead of $80M^3$ per day. The member from CGWA in the committee has prepared a site visit report and obtained the signature of the representative of the Respondent No.5 on the same in which all compliances to NOC conditions like validity, water consumption and Rainwater harvesting efforts by Respondent No.5, Installation piezometer, DWLR and Digital flow meter were written. Surprisingly that site visit report is not made a part/annexure to this report. The Respondent No.5 requests this Hon’ble Tribunal to direct the Respondent No.2 to produce the same on record.

51. The Respondent No.5 submits that with respect to the Recommendation No.1, the same is without technical backing and thus, not acceptable. The Respondent No.5 is granted and executed a mining lease over an area of 218.285Ha by State/Central Government for bauxite mining. Accordingly, as per law, the Respondent No. 5 is required to take EC for total area. The lease is being in private land, the Respondent No. 5 has taken the surface rights as per our requirement, because it carries cost. As per current mining plan the Respondent No. 5 has shown that it will be working in 63.585 hector out of 218.285 hector of area, to produce Bauxite, so the Respondent No. 5 took surface right for that much hector only. Once the Respondent No. 5 completes mining in that area then, it will switch over to other land and entered into agreement with land owner. Accordingly, the Respondent No.5 has obtained surface rights for 59.93Ha from landowners by way of agreement in which mining of bauxite is done, after that, once the land exhausted, it will be backfilled using the Overburden and intercalated waste and mineral rejects, and after that the cashew plantation is carried out and the land is returned to the landowner. Land acquisition by way of agreement is a continuous process for PP/Respondent No. 5. Land acquisition prior to obtaining EC is not mandatory for mining leases. For mining leases, EC is granted for total ML area awarded to PP for a specified quantity for excavation per annum. Moreover, the Respondent No. 5 along with the land also hands over the Cashew plantation and the produce to the land owner who earns a livelihood thereof.

52. The Respondent No.5 submits that the Recommendation No.2 is without technical backing and thus, not acceptable, considering the factual position that in EC it is mentioned that the Respondent No.5 is allowed to use the mobile crusher,. During the inspection it was informed to the Committee the mobile crushers which are crawler mounted and they fall under the category of Heavy Earthmoving Machinery. The Respondent No.5 practices in pit crushing and it is allied activity of mining and hence no separate consent is required to be obtained from Respondent No.3. If these crushers were standalone units and are fixed crushing units, then the issue of separate CTO would have arisen. The present CTO renewed by MPCB is worded as *Consent is valid for the manufacture of Bauxite Ore*… The word *manufacture* is wide enough to conclude that the movable crushers are covered in current CTO.

53. The Respondent No.5 submits that the Recommendation No.3 is without technical backing and thus, not acceptable. The committee failed to read the information provided by RTO wherein it is mentioned that load carrying capacity of the said bridge is 70R/9MT per axle which technically mean that when related to vehicle with twin axel, it can carry 18 tonnes, and this bridge is having twin axis and can be safe to carry 18 tonnes. The committee had somewhat exaggerated point of view about the situation. This is beyond the reference given to the Committee and beyond the purview of this Hon'ble Tribunal.

54. The Respondent No.5 submits that Recommendation No.4 is without technical backing and thus, not acceptable. The available infrastructure is used by the Respondent No.5 for mineral

transportation. The maintenance of public roads is the responsibility of concerned department irrespective of whether it is used for mineral transportation or for other purpose. The vehicles which transport mineral are duly registered by paying the applicable road tax and adhering to the emission norms set by the statue. The cost of maintenance of the infrastructural facilities cannot imposed upon the Respondent No.5 and Polluter Pay Principle cannot be made applicable here. The lessee is paying the royalty per metric tonne of the mineral dispatched from mines at the rate of 25% of the Average sale price declared by IBM per metric tonne and additionally 30% of the royalty is being paid to District Mineral Foundation. These funds are necessarily to be used by the Government for development, upliftment of mining affected area and for developing infrastructure in the mining affected area. It is a hostile recommendation by the committee and if implemented this will set a bad precedent and will be against the principle of natural justice.

55. The Respondent No.5 submits that the Recommendation No.5 is without technical backing and thus, not acceptable. The mining operations and dispatch of mineral is done through ILMS system which is fully online and without any manual intervention and additionally, lessee files monthly and annual returns giving the details of production, dispatch and sales etc. to state government and IBM, and a drone survey is required to be carried out by the lessee by the authorized agencies and submit the report is specified format to IBM. These surveillance/monitoring mechanisms which are in place already and with the statutory agencies. The mining activity is carried out by opencast method of mining in vast area at different

parts of the mining lease. CCTV surveillance for opencast mining is unheard of.

56. The committee has acted in a prejudiced manner in recommending imposition of Environment Damage Compensation without proper assessment, without proper study of the documents and clarifications submitted by the Respondent No.5 during the inspection and contradictory to their own observation of *5.2.3 Though at the time of visit, the exact status related to air pollution could not be verified.* The Respondent No.5 has not committed any violation related to tree plantation, mineral transportation and operation of crushers and hence this recommendation is not acceptable.

57. The committee has acted in an arbitrary manner in recommending imposition of Environment Damage Compensation for extraction of ground water without proper assessment, without proper study of the documents and clarifications submitted by the Respondent No.5 during the inspection.

58. It is thus submitted that the Applicants have failed to make out a case relating to the substantial question relating to the environment. The Committee has acted in an arbitrary manner and has prepared the report without due verification of the documents. The present Application is thus required to be dismissed with costs.

59. The Respondent No.5 submits that presently, entire activity is carried out by local villagers by way of providing trucks equipment and labours, means providing employment opportunity to nearly 1,000 people directly and indirectly. Also the Government is getting Rs.220/- per metric tonne by way of Royalty and 18% GST on

selling price. Nearly 150 trucks are working for this project. Hence, the present case is nothing but indirectly trying to snatch the livelihood of these people. The Respondent No.5 is a law abiding Company and committed to protect the environment.

60. The Respondent No.5, therefore prays that the present Original Application may kindly be disposed off with heavy costs in accordance to the provisions of Section 23 of the NGT Act, 2010.

Pune

Date : 23/08/2024

Advocate for Respondent No.5

BEFORE THE NATIONAL GREEN TRIBUNAL

WESTERN ZONE BENCH, PUNE

AT PUNE

ORIGINAL APPLICATION NO.74/2024(WZ)

BHAVESH ARUN KAREKAR & ANR. **APPLICANTS**

V/s

MoEF&CC & ORS. **RESPONDENTS**

AFFIDAVIT IN SUPPORT OF REPLY

MAY IT PLEASE THE HON'BLE TRIBUNAL

I, Hemul Shah, adult, Hindu, Indian, occupation: service, having office at Jeevan Udyog Building, 3rd floor, No. 278, Dr. D.N. Road, Fort, Mumbai, Maharashtra 400001, do hereby state on solemn affirmation as under: -

1. I say that I am the Authorised Signatory of the Respondent No.5 in the present case. I am aware of the facts and circumstances of the present case and hence am able to depose the same on oath.

2. I say that the Respondent No.5 is filing the Reply to the Original Application. I say that the contents of the said Reply and the present affidavit are true and correct to the best of my knowledge, information, belief and the legal advice which I believe to be correct.

NOTARY
S.M.H. ZAIDI
Mumbai & Thane Dist.
Reg.No. 3640
My Commission
Expires
25 Sept. 2026
GOVT. OF INDIA

WHATEVER stated herein above is true and correct to the best of my knowledge and belief and for the same I have signed hereunder at _____ on this _____ day of August, 2024.

23 AUG 2024

Deponent
Hemul Shah
(Authorised Signatory)
Ashapura Minechem Ltd.
Respondent No. 5

BEFORE ME

S. M. H. ZAIDI
NOTARY
Government of India
Mumbai & Thane Dist

23 AUG 2024

NOTED & REGISTERED
Sr. No. 1584 Page No. 114
Book No. 46 Date 23 AUG 2024

2023-2024

ANNEXURE-R-1

ENVIRONMENTAL COMPLIANCE REPORT

FOR THE PERIOD
OCTOBER 2023 TO MARCH 2024

Environmental Compliance Report for submission to the Ministry of Environment, Forests and Climate Change as a part of Environmental Clearance issued by MoEFCC vide No J-11015/417/2013-IA.II [M] for Rowale Bauxite Mine, ML Area 218.825 ha for mining 8.0 LTPA at Village Rowale, Dapoli Taluka, Ratnagiri District, Maharashtra.

BY

ASHAPURA MINECHEM LTD
Jeevan Udyog Building,3rd Floor, 278, D.N. Road, Fort, Mumbai-400 001

SUBMITTED TO

MINISTRY OF ENVIRONMENT, FORESTS & CLIMATE CHANGE

REGIONAL OFFICE (WESTERN REGION)

NEW SECRETARIAT BUILDING

NAGPUR

SIX MONTHLY COMPLIANCE REPORT ON ENVIRONMNETAL CLEARANCE CONDITIONS FOR THE PERIOD OCTOBER 2023 TO MARCH 2024

Name of the Project: **Rowale Bauxite Mine of M/s Ashapura Minechem Limited**, Village- Rowale, Taluka-Dapoli, Dist.- Ratnagiri, Maharashtra State.

Reference: Environmental Clearance issued by MoEFCC vide letter No-J-11015/417/ 2013-IA.II [M] Dated 24.02.2016.

A. Specific Conditions

Sl. No	Condition	Compliance status
(i)	Environmental clearance is granted subject to final outcome of Hon'ble Supreme Court of India, Hon'ble High Court of Maharashtra and any other Court of Law, if any, as may be applicable to this project.	Will be complied.
(ii)	Environmental clearance is subject to obtaining clearance, if any, under the Wildlife (Protection) Act, 1972 from the Competent Authority, as may be applicable to this project.	Clearance under Wildlife (Protection) Act, 1972 is not applicable as there are no wildlife sanctuaries, National Parks, Biosphere reserves, wildlife corridors within 10 km radius of the project boundary.
(iii)	No mining activities will be allowed in forest area, if any, for which the Forest Clearance is not available.	Forest clearance is not applicable as the entire lease area is Non-forest private patta land. Also, as per the records of revenue department in 7/12, the survey numbers under which lease falls is non forest land.
(iv)	The project proponent shall obtain Consent to Operate from the State Pollution Control Board, Maharashtra and effectively implement all the conditions stipulated therein.	Consent to Operate for mining 8.0 LTPA has been obtained from MPCB vide Consent No. Format1.0/APAE Section/ UAN No. MPCB-Consent-0000110617/CR/CC-397 Dated 07/12/2021.
(v)	A study from an Institution of Repute may be conducted on the impact of Bauxite dust on Crop Productivity in agricultural land located around mines and mitigation measures to be implemented by PP to reduce the impact.	We are carrying out adequate water sprinkling on the haul road and transport road on regular basis and the vehicles used for transportation are also covered with tarpaulin sheets due to which there is no impact on crop productivity in nearby areas.
(vi)	Recommendation by the Institute, for crops most suited in this environment and training to the farmers to switch over to new cropping system which will sustain nutrient loading.	Will be complied.
(vii)	Proponent shall carry out occupational Health surveillance for workers engaged in the project and records maintained and necessary remedial / preventive measures to be taken accordingly. Implementation of the recommendations of National Institute for ensuring good occupational environment for mine workers.	Initial medical examination and periodic medical examination of workers is being undertaken on regular basis from authorized medical officer and records are maintained.

Sl. No	Condition	Compliance status
(viii)	Use of mechanical devices for excavating the ore and reducing use of explosives.	HEMM is being used for excavating the ore. Drilling and blasting is being done to loosen the ore strata only. In order to minimize blasting, ripper dozer is also being practiced.
(ix)	Concurrent reclamation of mined out areas shall be done.	The reclamation of exhausted pits is being carried out as per Environmental Management Plan. Monitoring and management of rehabilitated area shall continue until the vegetation becomes self-sustaining.
(x)	Use of effective sprinkler system to suppress fugitive dust on haul roads and other transfer points and undertaking comprehensive study in a year's time for slope stabilization of mine benches and OB dumps.	In order to control the fugitive dust emission during mining operations, following arrangements has been provided: 1. Constructed ~160 m of black topped metalled road near weigh bridge, 2. Permanent water sprinkling system on main haul roads, 3. Constructed metalled road from mobile crusher unit to stack, 4. Water Sprinkling on haul road inside the lease and outside over the transport road by means of mobile water tankers, 5. Water sprinkling arrangements at the mobile crusher unit, As per the geological profile of the lease area, strata of the area consist of top soil (which is mostly absent) followed by laterite (seen as small capping at places) and Bauxite (average thickness of 4-5 m) followed by lithomarge and Basalt, is hard and compact in nature. Also the mining will be carried out by Open Cast Mining Method with single bench with a maximum working depth of around 6 m. Thus in this case, slope stabilization of mine bench is not required. Also as mentioned in the IBM approved mining scheme, there is no Topsoil or Overburden present. Thus, slope stabilization of OB dumps is also not required.
(xi)	Implementation of action plan on the issues raised during Public Hearing. The proponent shall complete all the tasks as per the action plan submitted with the budgetary provisions during the Public Hearing.	The issues raised during public hearing are being implemented in line with the submitted action plan. The proponent has committed to do CSR in the Public Hearing.

Sl. No	Condition	Compliance status
(xii)	The mining operations shall be restricted to above ground water table and it should not intersect groundwater table. Prior approval of the Ministry of Environment & Forests and Central Ground Water Authority shall be obtained for mining below water table.	The mining operations are restricted above ground water table and water table will not be intersected.
(xiii)	The project proponent shall ensure that no natural watercourse shall be obstructed due to any mining operations.	Is complied. No natural watercourse is obstructed due to any mining operations.
(xiv)	Top soil should be stacked with proper slope at earmarked site(s) only with adequate measures and should be used for reclamation and rehabilitation of mined out areas.	The entire mine lease area is having lateritic capping and there is no top soil in the lease area.
(xv)	The entire waste generated shall be backfilled and there shall be no external over burden dump left at the end of the mine life. The entire backfilled area shall be reclaimed by plantation. The backfilling should be carried out in such a manner that it is restored to the normal ground level. Monitoring and management of rehabilitated areas should continue until the vegetation becomes self-sustaining. Compliance status should be submitted to the Ministry of Environment & Forests and its Regional Office, Nagpur on six monthly basis.	No OB is present within lease area. However intercalated waste is generated which is used for backfilling the mine out areas. Monitoring and management of rehabilitated area shall continue until the vegetation becomes self-sustaining. Compliance Status in terms of Six Monthly Compliance Report is being submitted to the Regional Office of the MoEF&CC, Nagpur on regular basis.
(xvi)	Catch drains and siltation ponds of appropriate size should be constructed for the working pit, temporary OB dumps, if any and mineral dumps to arrest flow of silt and sediment. The water so collected should be utilized for watering the mine areas, roads, greenbelt development etc. The drains should be regularly desilted, particularly after monsoon, and maintained properly.	During pre-monsoon preparatory work, temporary catch drains / trenches are constructed around the working pits, mineral stacks and waste dumps to channelize the rain water towards mined out pits / rain water harvesting pits. Size, length and gradient of these drains depends upon the slope and distance from the pit. This water gets collected into the pits where it is allowed for sedimentation under gravity. Siltation ponds are also provided in the direction of overflow of these pits in order to arrest the silt flowing with the overflow, if any.
(xvii)	Garland drain of appropriate size, gradient and length shall be constructed for both mine pit and temporary dumps and sump capacity should be designed keeping 50% safety margin over and above peak sudden rainfall (based on 50 years data) and maximum discharge in the area adjoining the mine site. Sump capacity	Temporary garland drains are constructed around the working pits, mineral stacks and waste dumps to channelize the rain water towards mined out pits / rain water harvesting pits. Size, length and gradient of these drains depends upon the slope and distance from the pit. Garland drains are

Sl. No	Condition	Compliance status
	should also provide adequate retention period to allow proper settling of silt material. Sedimentation pits should be constructed at the corners of the garland drains and desilted at regular intervals.	desilted at regular intervals.
(xviii)	Dimensions of the retaining wall at the toe of temporary dumps and OB benches within the mine to check run-off and siltation should be based on the rainfall data.	There are no temporary dumps or OB benches with in the mine, however intercalated waste generated during mining operations is used for concurrent backfilling of mined out areas. Hence the construction of Retaining Wall does not necessitate.
(xix)	Plantation shall be raised in the specific area including a 7.5 m wide green belt in the safety zone around the mining lease by planting the native species around ML area, backfilled and reclaimed area, around water body, roads etc. in consultation with the local DFO/Agriculture Department. The density of the trees should be around 2500 plants per ha.	Plantation is being carried out over backfilled area, near the haul roads and along lease boundary. We have approached the Agriculture Officer, Dapoli for guidance on tree plantation. Monitoring and management of plantation area shall continue until the vegetation becomes self-sustaining.
(xx)	Regular water sprinkling shall be carried out in critical areas prone to air pollution and having high levels of SPM and RSPM such as haul road, loading and unloading point and transfer points. It should be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.	In order to suppress the dust generation at critical points following are the provision carried out: • Provided permanent water sprinkling system at the main haul road, • Provided permanent water sprinkling system at the mobile crusher units, • Constructed ~160 m black topped metalled road near weigh bridge within lease, • Also, deployed mobile water tankers for sprinkling on haul road with lease and transport road outside lease area. Ambient air quality monitoring is being done by MoEFCC approved lab and AAQ parameters are well within the permissible limits as specified by CPCB. Please refer **Annexure 1** for Ambient Air monitoring results.
(xxi)	The project authority should implement suitable conservation measures to augment ground water resources in the area in consultation with the Regional Director, Central Ground Water Board	For recharging groundwater, rain water is channelized into the mined out pits by the means of drains/ trenches. 2 rain water harvesting pits are present in the lease area. The dimensions of pits are as given below: Pit 1: 44 m x 8 m x 2.5 m Pit 2: 60 m x 10 m x 4.0 m
(xxii)	Regular monitoring of ground water level and quality should be carried out in and around the	Regular monitoring of water quality in and around the mining lease is being carried out

Sl. No	Condition	Compliance status
	mine lease by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring should be carried out four times in a year i.e. January, April-May, August, November and the data thus collected may be sent regularly to Ministry of Environment and Forests, its Regional Office, Nagpur; Central Ground Water Authority and Central Ground Water Board.	by MoEFCC approved laboratory. Piezometer has been constructed in Kelshi village to monitoring ground water.
(xxiii)	Vehicular emissions should be kept under control and regularly monitored. Measures shall be taken for maintenance of vehicles used in mining operations and in transportation of mineral. The vehicles should be covered with a tarpaulin and shall not be overloaded.	Vehicles are maintained on regular basis to have emission under control. All the vehicles are made mandatory to carry PUC certificate. Transportation of ore is being done through tarpaulin covered trucks only. There will be no overloading of trucks. Weigh bridges are being maintained at the outlet of mine area.
(xxiv)	Blasting operation should be carried out only during the daytime. Controlled blasting should be practiced. The Mitigative measures for control of ground vibrations and to arrest fly rocks and boulders should be implemented.	Blasting is done only to loosen the strata and is being done during day time only. Controlled blasting operations are carried out.
(xxv)	Drills shall either by operated with dust extractors or equipped with water injection system.	Drilling is being carried out using dust extractors along with wet drilling. To minimize blasting ripper-dozer is also used at mining site.
(xxvi)	A final mine closure plan along with details of Corpus Fund should be submitted to the Ministry of Environment & Forests 5 years in advance of final mine closure for approval.	Will be complied.
B: GENERAL CONDITIONS:		
(i)	No change in mining technology and scope of working shall be made without prior approval of Ministry of Environment and Forests.	There is no change in Mining technology.
(ii)	No change in calendar plan including excavation, quantum of mineral and waste shall be made.	Only calendar year plan as per approved Mining Plan is being followed for excavation quantum of mineral and waste.
(iii)	The project proponent shall obtain necessary prior permission of the competent authorities for drawl of requisite quantity of surface water and ground water for the project.	NOC from Central Ground Water Authority for abstraction of ground water has been obtained vide NOC No.: CGWA/NOC/MIN/REN/2/2022/7161 dated 18.12.2021.
(iv)	Regular monitoring of ground water table to be carried out at the upstream and depth of water available in the dug well to be measured.	Regular monitoring of water quality in and around the mining lease is being carried out by MoEFCC approved laboratory.

	Monitoring to be done by establishing a network of existing wells and constructing new piezometers.	Piezometer has been constructed in Kelshi village to monitoring ground water.
(v)	Monitoring of ambient air quality to be carried out based on the 2009 Notification, as amended from time to time by the Central Pollution Control Board. Water sprinkling should be increased at places i.e. loading and unloading points & transfer point to reduce fugitive emissions.	Ambient air quality monitoring is done in accordance with the notification issued by Central Pollution Control Board in 2009. Water sprinkling is done regularly at loading and unloading points and transfer point to reduce fugitive emission.
(vi)	The upliftment of scheduled caste/ scheduled tribe population, specific programmes have been taken into consideration especially with respect to education, health care, livelihood generation, infrastructure development and promotion of sports & culture for SC/ST population and that these will be intensified in future.	Due to mining activities, employment for the locals (as per their abilities) has been generated in the area. In-directly, in terms of small business opportunities like, garages for vehicles and equipment maintenance, spare parts shops, hardware shops, food stalls, local dabhas, local conveyance, local grocery shops etc. has been increased in the area. Also, company has given contracts to local villagers for providing water sprinkling tankers for dust control. Because of this, there is an increase in the money flow in the locals which eventually strengthen the socio-economic conditions of the area including the SC/ST population. The CSR activities carried out in the area during the reporting period area: • Providing education funds to the schools. • Donations for infrastructure development • Donation towards village development
(vii)	Plantation shall be raised in a 7.5 m wide greenbelt in the safety zone around the mining lease, backfilled and reclaimed area, around water body, along the roads etc. by planting the native species in consultation with the local DFO/Agriculture Department. The density of the trees should be around 2500 plants per ha. Greenbelt shall be developed all along the mine lease area in a phased manner and shall be completed within first five years.	Plantation is being carried out over backfilled area, near the haul roads and along lease boundary. We have approached the Agriculture Officer, Dapoli for guidance on tree plantation also plantation has been undertaken in consultation with the land owners. Owing to the canopy covers of planted trees, the density of trees is 2000/ha.
(viii)	Dimension of the retaining wall at the toe of over burden dumps and OB benches within the mine to check run-off and siltation shall be based on the rainfall data.	There are no temporary dumps or OB benches with in the mine, however intercalated waste is generated during mining operations is used for concurrent backfilling of mine out areas. Hence the construction of Retaining Wall does not necessitate.
(ix)	Effective safeguard measures such as regular water sprinkling shall be carried out in critical	In order to suppress the dust generation at critical points following are the provision

	areas prone to air pollution and having high levels of points. It shall be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.	carried out: • Provided permanent water sprinkling system at the main haul road, • Provided permanent water sprinkling system at the mobile crusher units, • Constructed ~160 m black topped metalled road near weigh bridge within lease, • Also, deployed mobile water tankers for sprinkling on haul road with lease and transport road outside lease area. Ambient air quality monitoring is being done by MoEFCC approved lab and AAQ parameters are within the permissible limits as specified by CPCB. Please refer **Annexure 1** for Ambient Air monitoring results.
(x)	Regular monitoring of the flow rate of the springs and perennial nallahs flowing in and around the mine lease shall be carried out and records maintained. Regular monitoring of water quality upstream and downstream of water bodies shall be carried out and record of monitoring data should be maintained and submitted to the Ministry of Environment, Forest & Climate Change, its Regional Office, Nagpur, Central Groundwater Authority, Regional Director, Central Ground Water Board, State Pollution Control Board and Central Pollution Control Board.	No springs and perennial nallahs are flowing in and around the lease area. Thus monitoring of spring and perennial nallahs is not envisaged. Regular monitoring of water quality and level is being carried out by MoEFCC approved lab and the report of the same is submitted to MoEFCC, Regional Office and MPCB, Chiplun on regular basis.
(xi)	Regular monitoring of ground water level and quality shall be carried out in and around the mine lease by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring shall be carried out four times in a year – Pre Monsoon (April – May), Monsoon (August), post – monsoon (November) and winter (January) and the data thus collected may be sent regularly to Ministry of Environment, Forest & Climate Change and its regional office, Nagpur, Central Ground Water Authority and Regional Director, Central Ground Water Board.	Regular monitoring of water quality in and around the mining lease is being carried out by MoEFCC approved laboratory and the report is sent regularly to MoEFCC, Nagpur and to the Sub-Regional Office, MPCB, Chiplun.
(xii)	The critical parameters such as PM_{10} (size less than 10 micro meter), $PM_{2.5}$(size less than 2.5 micro meter), NO_X in the ambient air within the impact zone, peak particle velocity at 300 m distance or within the nearest habitation, whichever is closer shall be monitored periodically. Further, quality of discharged	Regular monitoring of PM_{10}, $PM_{2.5}$, SO_X and NO_X is carried out regularly by MoEFCC approved laboratory and the report of same is submitted to MoEFCC, Regional Office, Nagpur and Sub-Regional Office, MPCB, Chiplun regularly. No discharge of water takes places from mining lease.

	water shall also be monitored [TDS, DO, PH and total suspended Solids (TSS)]. The monitored data shall be uploaded on the website of the company as well as displayed on a display board at the project site at a suitable location near the main gate of the company in public domain. The circular No, J-20012/1/2006-IA.II(M) dated 27.05.2009 issued by Ministry of Environment, Forests & Climate Change, which is available on the website of the Ministry https://parivesh.nic.in/ shall also be referred in this regard for its compliance.	
(xiii)	Four ambient air quality- monitoring stations shall be established in the core zone as well as in the buffer zone for RPM, SPM, SO_2, NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets and frequency of monitoring should be undertaken in consultation with the State Pollution Control Board. Data on ambient air quality should be regularly submitted to the Ministry including its Regional Office located at Nagpur and the State Pollution Control Board/ Central Pollution Control Board once in six months.	Six ambient air quality monitoring stations are established in core zone as well as in the buffer zone. Locations: a. Near Mining Pit, b. Near Mobile Crusher Unit, c. On Haul Road, d. In Rowale Village e. In Umbershet Village f. In Kavdoli Village Results of these are being submitted to the Sub-Regional Office, MPCB, Chiplun office on regular basis.
(xiv)	Fugitive dust emissions from all the sources shall be controlled regularly. Water spraying arrangement on haul roads, loading and unloading and at transfer points shall be provided and properly maintained.	In order to suppress fugitive dust following are the provision carried out: • Provided permanent water sprinkling system at the main haul road, • Provided permanent water sprinkling system at the mobile crusher units, • Constructed ~160 m black topped metalled road near weigh bridge within lease, • Also, deployed mobile water tankers for sprinkling on haul road with lease and transport road outside lease area.
(xv)	Measures shall be taken for control of noise level below 85 dB (A) in the work environment. Workers engaged in operations of HEMM, etc. shall be provided with ear plugs / muffs.	Adequate measures are taken to minimize the noise level by doing regular maintenance of all machineries. Workers engaged in operation of HEMM are provided with Ear Muffs.
(xvi)	Industrial Waste water (workshop & waste water from the mine) should be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May 1993 and 31st December, 1993 or as amended from time to time. Oil and Grease trap shall be installed before discharge of workshop	We have not established any workshop within the mining lease. Maintenance of all the vehicles and machineries are done at nearby town Dapoli in private garages. Waste water from the mine is not discharged into surface water and diverted to settling pond.

<table>
<tr><td></td><td>effluents.</td><td></td></tr>
<tr><td>(xvii)</td><td>Personnel working in dusty areas shall wear protective respiratory devices and they shall also be provided with adequate training and information on safety and health aspects.</td><td>Personnel working in dusty areas are provided with respiratory devices like masks and goggles. The information and training is provided to all on use of these devices.</td></tr>
<tr><td>(xviii)</td><td>Occupational health surveillance program of the workers should be undertaken periodically to observe any contractions due to exposure to dust and take corrective measures, if needed.</td><td>Initial medical examination and periodic medical examination of workers is being undertaken on regular basis from authorized medical officer and records are maintained.</td></tr>
<tr><td>(xix)</td><td>A separate environmental management cell with suitable qualified personnel shall be set up under the control of a Senior Executive, who will report directly to the Head of the Organization.</td><td>A separate Environmental Management cell with qualified personnel is set up.</td></tr>
<tr><td>(xx)</td><td>The funds earmarked for environmental protection measures shall be kept in separate account and should not be diverted for other purpose. Year wise expenditure shall be reported to the ministry and its Regional Office located at Nagpur.</td><td>The funds earmarked for Environmental protection work is kept separately. The expenditure occurred for above said job during last six month is Rs.13,66,831/-
<table><tr><th>Particular of the job</th><th>Expenditure (Rs.)</th></tr><tr><td>Environmental Monitoring</td><td>60,000/-</td></tr><tr><td>Water Sprinkling (Dust suppression)</td><td>12,46,831/-</td></tr><tr><td>Others (Road maintenance etc.)</td><td>60,000/-</td></tr><tr><td>TOTAL</td><td>13,66,831/-</td></tr></table></td></tr>
<tr><td>(xxi)</td><td>The project authorities should inform to the Regional office located at Nagpur regarding date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.</td><td>We are using our own resources and this clause is not applicable.</td></tr>
<tr><td>(xxii)</td><td>The Regional office of this Ministry located at Nagpur shall monitor compliance of the stipulated conditions. The project authorities should extend full co-operation to the officer (s) of the Regional office by furnishing the requisite data / information / monitoring reports.</td><td>The project authorities will extend co-operation to any of the concerned officer by furnishing the requisite data.</td></tr>
<tr><td>(xxiii)</td><td>The project proponent shall submit six monthly report on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment, Forest and Climate Change, its regional Office, Nagpur, Central Pollution Control Board and State Pollution Control Board.</td><td>Six monthly report on the status on the implementation of the stipulated environmental safeguards is submitted to MoEFCC, Regional Office and MPCB, Chiplun on regular basis.</td></tr>
<tr><td>(xxiv)</td><td>The project proponent shall submit six monthly report on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment, Forest and Climate</td><td>Six monthly report on the status on the implementation of the stipulated environmental safeguards is submitted to MoEFCC, Regional Office and MPCB,</td></tr>
</table>

	Change, its Regional Office, Nagpur, Central Pollution Control Board and State Pollution Control Board.	Chiplun on regular basis.
(xxv)	A copy of Clearance letter will be marked to concern Panchayat / local NGO, if any, from whom suggestion / representation has been received while processing the proposal.	Complied.
(xxvi)	State Pollution Control Board should display a copy of the clearance letter at the Regional office, District industry Centre and collector's office / Tehsildars office for 30 days.	Not Applicable
(xxvii)	The project authorities shall advertise at least in two local newspapers widely circulated, one of which shall be in the vernacular language of the locality concerned, within 7 days of the issue of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance and a copy of the clearance letter is available with the State Pollution Control Board and also at web site of the Ministry of Environment and Forests at http:// envfor.nic.in and a copy of the same shall be forwarded to the Regional Office of this Ministry located at Nagpur.	Complied.

Date: 15.04.2024

ASHAPURA MINECHEM LTD. MUMBAI

For, Ashapura Minechem Limited.

Place: Mumbai

Authorized Signatory

Annexure-1: Ambient Air quality Monitoring Results 2023- 2024

S. No.	Locations	January 2024					February 2024					March 2024				
		Parameters (µg/m^3)					Parameters (µg/m^3)					Parameters (µg/m^3)				
		PM_{10}	$PM_{2.5}$	SO_X	NO_X	Silica	PM_{10}	$PM_{2.5}$	SO_X	NO_X	Silica	PM_{10}	$PM_{2.5}$	SO_X	NO_X	Silica
1.	Crushing Plant	83.20	39.50	8.20	16.60	0.03	82.20	38.80	7.20	16.40	0.04	81.50	39.20	8.10	16.30	0.03
2.	Haulage Road	85.30	41.10	6.70	19.50	0.03	84.30	42.20	6.60	20.50	0.03	85.20	41.30	7.30	17.40	0.03
3.	Near Mining Pit	82.40	40.30	7.50	15.10	0.03	81.20	38.40	7.40	14.60	0.03	80.20	37.60	7.30	14.30	0.03
4.	Umbershet Village	80.50	39.20	7.50	15.50	-	81.20	39.20	7.50	16.20	-	81.70	39.50	7.00	15.00	-
5.	Rowale Village	81.60	38.50	6.80	14.80	-	80.70	38.20	7.10	14.50	-	81.50	38.30	7.10	14.70	-
6.	Kavadoli Village	80.20	38.30	6.80	14.80	-	80.30	37.50	6.20	14.50	-	81.30	37.50	6.20	14.00	-

Permissible limits as per NAAQS Standards

PM_{10} 100 µg/m^3

$PM_{2.5}$ 60 µg/m^3

SO_X 80 µg/m^3

NO_X 80 µg/m^3

ANNEXURE-R-2

By Regd. AD Post

ASHAPURA
MINECHEM LIMITED

To:

Date: 25.11.2023

The Sub Regional Officer,
Chiplun
Maharashtra State Pollution Control Board
Sub Regional Office, Chiplun
2nd Floor Parkar Complex,
224, Behind Nagar Parishad, Tal. Chiplun,
District Ratnagiri 415605

Subject: Warning Notice reg.

Ref.: Your office letter No. MPCB/SROCH/0283/23 dated 21/11/2023

Dear Sir,

With respect to above mentioned reference, submitting the compliance in respect of our Rowale Bauxite Mines TQ Dapoli, District Ratnagiri for your kind perusal.

- As observed during the visit, the mining and allied activities are not yet started at this mine.
- During the transportation, system generated integrated DMO transit pass is issued to the driver of the truck which is as per the statutory format.
- Enough water tankers are deployed for dust suppression and the frequency of same will be increased once the mining and allied activity is resumed full-fledged.
- As on date about 15Ha area is rehabilitated with about 17,798 cashew plants and the landowner is earning form the harvest.
- We have taken all the required steps towards Conservation of Environment at the mines as per the statutory guidelines.
- The mine is located well away from the places of human habitat and no health problems associated with mining of bauxite is reported till date.
- The local people are well absorbed in the mining and allied activities through direct and indirect employment thus contributing to their wellbeing.
- The mining activity is carried out in barren, uncultivable land, and no abnormal impact on agriculture productivity due to mining is observed.
- Reclamation and rehabilitated is being carried out in scientific manner as prescribed by the statutory agencies.
- The trucks are being loaded as per prescribed statutory norms and tarpaulin covering is ensured before it leaves mines premises.

Regd. Office :
Jeevan Udyog Building, 3rd Floor, 278, D. N. Road, Fort, Mumbai - 400 001. (India)
Tel.: +91-22 6665 1700 ▫ Email: info@ashapura.com ▫ www.ashapura.com

CIN-No. L14108MH1982PLC026396

Continuation Sheet

ASHAPURA

- The Google imagery can't be construed as tool to identify afforestation and we are carrying out afforestation as per the statutory norms.
- Six monthly EC compliance report is enclosed for your kind perusal.
- Air, water, noise, and soil samples are collected and analysed by NABL accredited laboratory as per EMP and it is observed that all the parameters are well within the prescribed norms. The proper mitigation methods are deployed wherever required to minimise the pollution at the source of generation itself.

Though, we do not have the copy of the complaint by Mr. Bhavesh Karekar, it seems like the complainant is having some hidden agenda to vilify, harass and extort the organization by falsification of data, incomplete knowledge about the mining process, exaggerating the facts and selective display of sponsored negativity which will have significant impact on local development, revenue to the exchequer and loss of direct and indirect employment to the local community.

We here by request your kind self to accept the compliance and oblige.

Thanking you,

25/11/2023

For M/s Ashapura Minechem Ltd.

Authorized Signatory

Cc. The Regional Officer, MPC Board, Kolhapur

ENVIRONMENTAL COMPLIANCE REPORT

FOR THE PERIOD
APRIL 2023 TO SEPTEMBER 2023

Environmental Compliance Report for submission to the Ministry of Environment, Forests and Climate Change as a part of Environmental Clearance issued by MoEFCC vide No J-11015/417/2013-IA.II [M] for Rowale Bauxite Mine, ML Area 218.825 ha for mining 8.0 LTPA at Village Rowale, Dapoli Taluka, Ratnagiri District, Maharashtra.

BY

ASHAPURA MINECHEM LTD
Jeevan Udyog Building,3rd Floor,278,D.N.Road,Fort,Mumbai-400 001

SUBMITTED TO

MINISTRY OF ENVIRONMENT, FORESTS & CLIMATE CHANGE

REGIONAL OFFICE (WESTERN REGION)

NEW SECRETARIAT BUILDING

NAGPUR

SIX MONTHLY COMPLIANCE REPORT ON ENVIRONMNETAL CLEARANCE CONDITIONS FOR THE PERIOD APRIL 2023 TO SEPTEMBER 2023

Name of the Project: **Rowale Bauxite Mine of M/s Ashapura Minechem Limited**, Village- Rowale, Taluka-Dapoli, Dist.- Ratnagiri, Maharashtra State.

Reference: Environmental Clearance issued by MoEFCC vide letter No-J-11015/417/ 2013-IA.II [M] Dated 24.02.2016.

A. Specific Conditions

Sl. No	Condition	Compliance status
(i)	Environmental clearance is granted subject to final outcome of Hon'ble Supreme Court of India, Hon'ble High Court of Maharashtra and any other Court of Law, if any, as may be applicable to this project.	Will be complied.
(ii)	Environmental clearance is subject to obtaining clearance, if any, under the Wildlife (Protection) Act, 1972 from the Competent Authority, as may be applicable to this project.	Clearance under Wildlife (Protection) Act, 1972 is not applicable as there are no wildlife sanctuaries, National Parks, Biosphere reserves, wildlife corridors within 10 km radius of the project boundary.
(iii)	No mining activities will be allowed in forest area, if any, for which the Forest Clearance is not available.	Forest clearance is not applicable as the entire lease area is Non-forest private patta land. Also, as per the records of revenue department in 7/12, the survey numbers under which lease falls is non forest land.
(iv)	The project proponent shall obtain Consent to Operate from the State Pollution Control Board, Maharashtra and effectively implement all the conditions stipulated therein.	Consent to Operate for mining 8.0 LTPA has been obtained from MPCB vide Consent No. BO/JD(APC)/UAN No. 66905/O/CC-1178 dated 26.11.2019.
(v)	A study from an Institution of Repute may be conducted on the impact of Bauxite dust on Crop Productivity in agricultural land located around mines and mitigation measures to be implemented by PP to reduce the impact.	We are carrying out adequate water sprinkling on the haul road and transport road on regular basis and the vehicles used for transportation are also covered with tarpaulin sheets due to which there is no impact on crop productivity in nearby areas.
(vi)	Recommendation by the Institute, for crops most suited in this environment and training to the farmers to switch over to new cropping system which will sustain nutrient loading.	Will be complied.
(vii)	Proponent shall carry out occupational Health surveillance for workers engaged in the project and records maintained and necessary remedial / preventive measures to be taken accordingly. Implementation of the recommendations of National Institute for ensuring good occupational environment for mine workers.	Initial medical examination and periodic medical examination of workers is being undertaken on regular basis from authorized medical officer and records are maintained.

Sl. No	Condition	Compliance status
(viii)	Use of mechanical devices for excavating the ore and reducing use of explosives.	HEMM is being used for excavating the ore. Drilling and blasting is being done to loosen the ore strata only. In order to minimize blasting, ripper dozer is also being practiced.
(ix)	Concurrent reclamation of mined out areas shall be done.	The reclamation of exhausted pits is being carried out as per Environmental Management Plan. Monitoring and management of rehabilitated area shall continue until the vegetation becomes self-sustaining.
(x)	Use of effective sprinkler system to suppress fugitive dust on haul roads and other transfer points and undertaking comprehensive study in a year's time for slope stabilization of mine benches and OB dumps.	In order to control the fugitive dust emission during mining operations, following arrangements has been provided: 1. Constructed ~160 m of black topped metalled road near weigh bridge, 2. Permanent water sprinkling system on main haul roads, 3. Constructed metalled road from mobile crusher unit to stack, 4. Water Sprinkling on haul road inside the lease and outside over the transport road by means of mobile water tankers, 5. Water sprinkling arrangements at the mobile crusher unit, Please refer **Annexure 1** for the Environment Management Practices followed for dust control. As per the geological profile of the lease area, strata of the area consist of top soil (which is mostly absent) followed by laterite (seen as small capping at places) and Bauxite (average thickness of 4-5 m) followed by lithomarge and Basalt, is hard and compact in nature. Also the mining will be carried out by Open Cast Mining Method with single bench with a maximum working depth of around 6 m. Thus in this case, slope stabilization of mine bench is not required. Also as mentioned in the IBM approved mining scheme, there is no Topsoil or Overburden present. Thus, slope stabilization of OB dumps is also not required.
(xi)	Implementation of action plan on the issues raised during Public Hearing. The proponent shall complete all the tasks as per the action plan submitted with the budgetary provisions during the Public Hearing.	The issues raised during public hearing are being implemented in line with the submitted action plan. The proponent has committed to do CSR in the Public Hearing.

Sl. No	Condition	Compliance status
(xii)	The mining operations shall be restricted to above ground water table and it should not intersect groundwater table. Prior approval of the Ministry of Environment & Forests and Central Ground Water Authority shall be obtained for mining below water table.	The mining operations are restricted above ground water table and water table will not be intersected.
(xiii)	The project proponent shall ensure that no natural watercourse shall be obstructed due to any mining operations.	Is complied. No natural watercourse is obstructed due to any mining operations.
(xiv)	Top soil should be stacked with proper slope at earmarked site(s) only with adequate measures and should be used for reclamation and rehabilitation of mined out areas.	The entire mine lease area is having lateritic capping and there is no top soil in the lease area.
(xv)	The entire waste generated shall be backfilled and there shall be no external over burden dump left at the end of the mine life. The entire backfilled area shall be reclaimed by plantation. The backfilling should be carried out in such a manner that it is restored to the normal ground level. Monitoring and management of rehabilitated areas should continue until the vegetation becomes self-sustaining. Compliance status should be submitted to the Ministry of Environment & Forests and its Regional Office, Nagpur on six monthly basis.	No OB is present within lease area. However intercalated waste is generated which is used for backfilling the mine out areas. Monitoring and management of rehabilitated area shall continue until the vegetation becomes self-sustaining. Compliance Status in terms of Six Monthly Compliance Report is being submitted to the Regional Office of the MoEF&CC, Nagpur on regular basis.
(xvi)	Catch drains and siltation ponds of appropriate size should be constructed for the working pit, temporary OB dumps, if any and mineral dumps to arrest flow of silt and sediment. The water so collected should be utilized for watering the mine areas, roads, greenbelt development etc. The drains should be regularly desilted, particularly after monsoon, and maintained properly.	During pre-monsoon preparatory work, temporary catch drains / trenches are constructed around the working pits, mineral stacks and waste dumps to channelize the rain water towards mined out pits / rain water harvesting pits. Size, length and gradient of these drains depends upon the slope and distance from the pit. This water gets collected into the pits where it is allowed for sedimentation under gravity. Siltation ponds are also provided in the direction of overflow of these pits in order to arrest the silt flowing with the overflow, if any. Please refer **Annexure 2** for the photographs showing the Environment Management Practices (EMPs) carried out for water conservation.
(xvii)	Garland drain of appropriate size, gradient and length shall be constructed for both mine pit and temporary dumps and sump capacity	Temporary garland drains are constructed around the working pits, mineral stacks and waste dumps to channelize the rain water

Sl. No	Condition	Compliance status
	should be designed keeping 50% safety margin over and above peak sudden rainfall (based on 50 years data) and maximum discharge in the area adjoining the mine site. Sump capacity should also provide adequate retention period to allow proper settling of silt material. Sedimentation pits should be constructed at the corners of the garland drains and desilted at regular intervals.	towards mined out pits / rain water harvesting pits. Size, length and gradient of these drains depends upon the slope and distance from the pit. Garland drains are desilted at regular intervals.
(xviii)	Dimensions of the retaining wall at the toe of temporary dumps and OB benches within the mine to check run-off and siltation should be based on the rainfall data.	There are no temporary dumps or OB benches with in the mine, however intercalated waste generated during mining operations is used for concurrent backfilling of mined out areas. Hence the construction of Retaining Wall does not necessitate.
(xix)	Plantation shall be raised in the specific area including a 7.5 m wide green belt in the safety zone around the mining lease by planting the native species around ML area, backfilled and reclaimed area, around water body, roads etc. in consultation with the local DFO/Agriculture Department. The density of the trees should be around 2500 plants per ha.	Plantation is being carried out over backfilled area, near the haul roads and along lease boundary. We have approached the Agriculture Officer, Dapoli for guidance on tree plantation. Monitoring and management of plantation area shall continue until the vegetation becomes self-sustaining. Please refer **Annexure 3** for Plantation Photographs.
(xx)	Regular water sprinkling shall be carried out in critical areas prone to air pollution and having high levels of SPM and RSPM such as haul road, loading and unloading point and transfer points. It should be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.	In order to suppress the dust generation at critical points following are the provision carried out: • Provided permanent water sprinkling system at the main haul road, • Provided permanent water sprinkling system at the mobile crusher units, • Constructed ~160 m black topped metalled road near weigh bridge within lease, • Also, deployed mobile water tankers for sprinkling on haul road with lease and transport road outside lease area. Please refer **Annexure 1** for the EMPs carried out for Air Pollution Control. Ambient air quality monitoring is being done by MoEFCC approved lab and AAQ parameters are well within the permissible limits as specified by CPCB. Please refer **Annexure 4** for Ambient Air monitoring results.

Sl. No	Condition	Compliance status
(xxi)	The project authority should implement suitable conservation measures to augment ground water resources in the area in consultation with the Regional Director, Central Ground Water Board	For recharging groundwater, rain water is channelized into the mined out pits by the means of drains/ trenches. 2 rain water harvesting pits are present in the lease area. The dimensions of pits are as given below: Pit 1: 44 m x 8 m x 2.5 m Pit 2: 60 m x 10 m x 4.0 m
(xxii)	Regular monitoring of ground water level and quality should be carried out in and around the mine lease by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring should be carried out four times in a year i.e. January, April-May, August, November and the data thus collected may be sent regularly to Ministry of Environment and Forests, its Regional Office, Nagpur; Central Ground Water Authority and Central Ground Water Board.	Regular monitoring of water quality in and around the mining lease is being carried out by MoEFCC approved laboratory. Piezometer has been constructed in Kelshi village to monitoring ground water.
(xxiii)	Vehicular emissions should be kept under control and regularly monitored. Measures shall be taken for maintenance of vehicles used in mining operations and in transportation of mineral. The vehicles should be covered with a tarpaulin and shall not be overloaded.	Vehicles are maintained on regular basis to have emission under control. All the vehicles are made mandatory to carry PUC certificate. Transportation of ore is being done through tarpaulin covered trucks only. There will be no overloading of trucks. Weigh bridges are being maintained at the outlet of mine area.
(xxiv)	Blasting operation should be carried out only during the daytime. Controlled blasting should be practiced. The Mitigative measures for control of ground vibrations and to arrest fly rocks and boulders should be implemented.	Blasting is done only to loosen the strata and is being done during day time only. Controlled blasting operations are carried out.
(xxv)	Drills shall either by operated with dust extractors or equipped with water injection system.	Drilling is being carried out using dust extractors along with wet drilling. To minimize blasting ripper-dozer is also used at mining site.
(xxvi)	A final mine closure plan along with details of Corpus Fund should be submitted to the Ministry of Environment & Forests 5 years in advance of final mine closure for approval.	Will be complied.
B: GENERAL CONDITIONS:		
(i)	No change in mining technology and scope of working shall be made without prior approval of Ministry of Environment and Forests.	There is no change in Mining technology.
(ii)	No change in calendar plan including	Only calendar year plan as per approved

	excavation, quantum of mineral and waste shall be made.	Mining Plan is being followed for excavation quantum of mineral and waste.
(iii)	The project proponent shall obtain necessary prior permission of the competent authorities for drawl of requisite quantity of surface water and ground water for the project.	NOC from Central Ground Water Authority for abstraction of ground water has been obtained vide NOC No.: CGWA/NOC/MIN/ORIG/2017/2893 dated 18.12.2017. The NOC is attached as **Annexure 5.**
(iv)	Regular monitoring of ground water table to be carried out at the upstream and depth of water available in the dug well to be measured. Monitoring to be done by establishing a network of existing wells and constructing new piezometers.	Regular monitoring of water quality in and around the mining lease is being carried out by MoEFCC approved laboratory. Piezometer has been constructed in Kelshi village to monitoring ground water.
(v)	Monitoring of ambient air quality to be carried out based on the 2009 Notification, as amended from time to time by the Central Pollution Control Board. Water sprinkling should be increased at places i.e. loading and unloading points & transfer point to reduce fugitive emissions.	Ambient air quality monitoring is done in accordance with the notification issued by Central Pollution Control Board in 2009. Water sprinkling is done regularly at loading and unloading points and transfer point to reduce fugitive emission.
(vi)	The upliftment of scheduled caste/ scheduled tribe population, specific programmes have been taken into consideration especially with respect to education, health care, livelihood generation, infrastructure development and promotion of sports & culture for SC/ST population and that these will be intensified in future.	Due to mining activities, employment for the locals (as per their abilities) has been generated in the area. In-directly, in terms of small business opportunities like, garages for vehicles and equipment maintenance, spare parts shops, hardware shops, food stalls, local dabhas, local conveyance, local grocery shops etc. has been increased in the area. Also, company has given contracts to local villagers for providing water sprinkling tankers for dust control. Because of this, there is an increase in the money flow in the locals which eventually strengthen the socio-economic conditions of the area including the SC/ST population. The CSR activities carried out in the area during the reporting period area: • Providing education funds to the schools. • Donations for infrastructure development • Donation towards village development
(vii)	Plantation shall be raised in a 7.5 m wide greenbelt in the safety zone around the mining lease, backfilled and reclaimed area, around water body, along the roads etc. by planting the native species in consultation with the local DFO/Agriculture Department. The density of the trees should be around 2500 plants per ha.	Plantation is being carried out over backfilled area, near the haul roads and along lease boundary. We have approached the Agriculture Officer, Dapoli for guidance on tree plantation also plantation has been undertaken in consultation with the land owners. Owing to the canopy covers of

	Greenbelt shall be developed all along the mine lease area in a phased manner and shall be completed within first five years.	planted trees, the density of trees is 2000/ha. Please refer **Annexure 4** for Plantation Photographs.
(viii)	Dimension of the retaining wall at the toe of over burden dumps and OB benches within the mine to check run-off and siltation shall be based on the rainfall data.	There are no temporary dumps or OB benches with in the mine, however intercalated waste is generated during mining operations is used for concurrent backfilling of mine out areas. Hence the construction of Retaining Wall does not necessitate.
(ix)	Effective safeguard measures such as regular water sprinkling shall be carried out in critical areas prone to air pollution and having high levels of points. It shall be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.	In order to suppress the dust generation at critical points following are the provision carried out: • Provided permanent water sprinkling system at the main haul road, • Provided permanent water sprinkling system at the mobile crusher units, • Constructed ~160 m black topped metalled road near weigh bridge within lease, • Also, deployed mobile water tankers for sprinkling on haul road with lease and transport road outside lease area. Please refer **Annexure 1** for the EMPs carried out for Air Pollution Control. Ambient air quality monitoring is being done by MoEFCC approved lab and AAQ parameters are within the permissible limits as specified by CPCB. Please refer **Annexure 4** for Ambient Air monitoring results.
(x)	Regular monitoring of the flow rate of the springs and perennial nallahs flowing in and around the mine lease shall be carried out and records maintained. Regular monitoring of water quality upstream and downstream of water bodies shall be carried out and record of monitoring data should be maintained and submitted to the Ministry of Environment, Forest & Climate Change, its Regional Office, Nagpur, Central Groundwater Authority, Regional Director, Central Ground Water Board, State Pollution Control Board and Central Pollution Control Board.	No springs and perennial nallahs are flowing in and around the lease area. Thus monitoring of spring and perennial nallahs is not envisaged. Regular monitoring of water quality and level is being carried out by MoEFCC approved lab and the report of the same is submitted to MoEFCC, Regional Office and MPCB, Chiplun on regular basis.
(xi)	Regular monitoring of ground water level and quality shall be carried out in and around the mine lease by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring shall be carried out four times in a year – Pre Monsoon (April – May), Monsoon (August), post –	Regular monitoring of water quality in and around the mining lease is being carried out by MoEFCC approved laboratory and the report is sent regularly to MoEFCC, Nagpur and to the Sub-Regional Office, MPCB, Chiplun.

	monsoon (November) and winter (January) and the data thus collected may be sent regularly to Ministry of Environment, Forest & Climate Change and its regional office, Nagpur, Central Ground Water Authority and Regional Director, Central Ground Water Board.	
(xii)	The critical parameters such as PM_{10} (size less than 10 micro meter), $PM_{2.5}$(size less than 2.5 micro meter), NO_X in the ambient air within the impact zone, peak particle velocity at 300 m distance or within the nearest habitation, whichever is closer shall be monitored periodically. Further, quality of discharged water shall also be monitored [TDS, DO, PH and total suspended Solids (TSS)]. The monitored data shall be uploaded on the website of the company as well as displayed on a display board at the project site at a suitable location near the main gate of the company in public domain. The circular No, J-20012/1/2006-IA.II(M) dated 27.05.2009 issued by Ministry of Environment, Forests & Climate Change, which is available on the website of the Ministry www.emvfor.nic.in shall also be referred in this regard for its compliance.	Regular monitoring of PM_{10}, $PM_{2.5}$, SO_X and NO_X is carried out regularly by MoEFCC approved laboratory and the report of same is submitted to MoEFCC, Regional Office, Nagpur and Sub-Regional Office, MPCB, Chiplun regularly. No discharge of water takes places from mining lease.
(xiii)	Four ambient air quality- monitoring stations shall be established in the core zone as well as in the buffer zone for RPM, SPM, SO_2, NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets and frequency of monitoring should be undertaken in consultation with the State Pollution Control Board. Data on ambient air quality should be regularly submitted to the Ministry including its Regional Office located at Nagpur and the State Pollution Control Board/ Central Pollution Control Board once in six months.	Six ambient air quality monitoring stations are established in core zone as well as in the buffer zone. Locations: a. Near Mining Pit, b. Near Mobile Crusher Unit, c. On Haul Road, d. In Rowale Village e. In Umbershet Village f. In Kavdoli Village Results of these are being submitted to the Sub-Regional Office, MPCB, Chiplun office on regular basis.
(xiv)	Fugitive dust emissions from all the sources shall be controlled regularly. Water spraying arrangement on haul roads, loading and unloading and at transfer points shall be provided and properly maintained.	In order to suppress fugitive dust following are the provision carried out: • Provided permanent water sprinkling system at the main haul road, • Provided permanent water sprinkling system at the mobile crusher units, • Constructed ~160 m black topped metalled road near weigh bridge within lease, • Also, deployed mobile water tankers for sprinkling on haul road with lease and

<table>
<tr><td></td><td></td><td>transport road outside lease area.
Please refer Annexure 1 for the EMPs carried out for Air Pollution Control.</td></tr>
<tr><td>(xv)</td><td>Measures shall be taken for control of noise level below 85 dB (A) in the work environment. Workers engaged in operations of HEMM, etc. shall be provided with ear plugs / muffs.</td><td>Adequate measures are taken to minimize the noise level by doing regular maintenance of all machineries. Workers engaged in operation of HEMM are provided with Ear Muffs.</td></tr>
<tr><td>(xvi)</td><td>Industrial Waste water (workshop & waste water from the mine) should be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May 1993 and 31st December, 1993 or as amended from time to time. Oil and Grease trap shall be installed before discharge of workshop effluents.</td><td>We have not established any workshop within the mining lease. Maintenance of all the vehicles and machineries are done at nearby town Dapoli in private garages. Waste water from the mine is not discharged into surface water and diverted to settling pond.</td></tr>
<tr><td>(xvii)</td><td>Personnel working in dusty areas shall wear protective respiratory devices and they shall also be provided with adequate training and information on safety and health aspects.</td><td>Personnel working in dusty areas are provided with respiratory devices like masks and goggles. The information and training is provided to all on use of these devices.</td></tr>
<tr><td>(xviii)</td><td>Occupational health surveillance program of the workers should be undertaken periodically to observe any contractions due to exposure to dust and take corrective measures, if needed.</td><td>Initial medical examination and periodic medical examination of workers is being undertaken on regular basis from authorized medical officer and records are maintained.</td></tr>
<tr><td>(xix)</td><td>A separate environmental management cell with suitable qualified personnel shall be set up under the control of a Senior Executive, who will report directly to the Head of the Organization.</td><td>A separate Environmental Management cell with qualified personnel is set up.</td></tr>
<tr><td>(xx)</td><td>The funds earmarked for environmental protection measures shall be kept in separate account and should not be diverted for other purpose. Year wise expenditure shall be reported to the ministry and its Regional Office located at Nagpur.</td><td>The funds earmarked for Environmental protection work is kept separately. The expenditure occurred for above said job during last six month is Rs.13,66,831/-
<table>
<tr><th>Particular of the job</th><th>Expenditure (Rs.)</th></tr>
<tr><td>Environmental Monitoring</td><td>60,000/-</td></tr>
<tr><td>Water Sprinkling (Dust suppression)</td><td>12,46,831/-</td></tr>
<tr><td>Others (Road maintenance etc.)</td><td>60,000/-</td></tr>
<tr><td>TOTAL</td><td>13,66,831/-</td></tr>
</table></td></tr>
<tr><td>(xxi)</td><td>The project authorities should inform to the Regional office located at Nagpur regarding date of financial closure and final approval of the project by the concerned authorities and the date of start of land development work.</td><td>We are using our own resources and this clause is not applicable.</td></tr>
<tr><td>(xxii)</td><td>The Regional office of this Ministry located at Nagpur shall monitor compliance of the stipulated conditions. The project authorities</td><td>The project authorities will extend co-operation to any of the concerned officer by furnishing the requisite data.</td></tr>
</table>

	should extend full co-operation to the officer (s) of the Regional office by furnishing the requisite data / information / monitoring reports.	
(xxiii)	The project proponent shall submit six monthly report on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment, Forest and Climate Change, its regional Office, Nagpur, Central Pollution Control Board and State Pollution Control Board.	Six monthly report on the status on the implementation of the stipulated environmental safeguards is submitted to MoEFCC, Regional Office and MPCB, Chiplun on regular basis.
(xxiv)	The project proponent shall submit six monthly report on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment, Forest and Climate Change, its Regional Office, Nagpur, Central Pollution Control Board and State Pollution Control Board.	Six monthly report on the status on the implementation of the stipulated environmental safeguards is submitted to MoEFCC, Regional Office and MPCB, Chiplun on regular basis.
(xxv)	A copy of Clearance letter will be marked to concern Panchayat / local NGO, if any, from whom suggestion / representation has been received while processing the proposal.	Complied.
(xxvi)	State Pollution Control Board should display a copy of the clearance letter at the Regional office, District industry Centre and collector's office / Tehsildars office for 30 days.	Not Applicable
(xxvii)	The project authorities shall advertise at least in two local newspapers widely circulated, one of which shall be in the vernacular language of the locality concerned, within 7 days of the issue of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance and a copy of the clearance letter is available with the State Pollution Control Board and also at web site of the Ministry of Environment and Forests at http:// envfor.nic.in and a copy of the same shall be forwarded to the Regional Office of this Ministry located at Nagpur.	Complied.
Date: 12.11.2023		**For, Ashapura Minechem Limited.**
Place: Mumbai		**Authorized Signatory**

Annexure-4: Ambient Air quality Monitoring Results 2019- 2020

S. No.	Locations	April 2023					May 2023					June 2023				
		Parameters (µg/m^3)					Parameters (µg/m^3)					Parameters (µg/m^3)				
		PM_{10}	$PM_{2.5}$	SO_X	NO_X	Silica	PM_{10}	$PM_{2.5}$	SO_X	NO_X	Silica	PM_{10}	$PM_{2.5}$	SO_X	NO_X	Silica
1.	Crushing Plant	86.66	44.21	7.34	12.68	0.03	88.89	43.75	6.58	13.69	0.02	85.48	42.75	6.29	12.64	0.02
2.	Haulage Road	85.33	42.51	7.13	11.79	0.03	86.59	43.06	6.64	12.75	0.02	82.84	42.18	6.56	13.48	0.02
3.	Near Mining Pit	85.86	42.70	7.14	12.25	0.03	84.48	43.23	6.95	13.10	0.02	85.68	41.44	6.83	13.65	0.02
4.	Umbershet Village	80.01	35.08	6.09	10.39	-	79.29	33.61	5.95	12.53	-	79.28	38.54	6.01	11.13	-
5.	Rowale Village	79.59	37.38	5.85	10.08	-	78.39	37.38	6.01	10.56	-	80.08	38.35	6.09	11.01	-
6.	Kavadoli Village	76.89	34.78	5.85	9.81	-	76.54	35.99	6.08	10.45	-	75.36	36.13	5.84	12.01	-

Permissible limits as per NAAQS Standards

PM_{10} 100 µg/m^3

$PM_{2.5}$ 60 µg/m^3

SO_X 80 µg/m^3

NO_X 80 µg/m^3

ANNEXURE-R-3

ASHAPURA
MINECHEM LIMITED

To:

Date: 30.04.2024

The Regional Officer,
Maharashtra State Pollution Control Board
Regional Office, Kolhapur
Udyog Bhavan,
Near Collector Office,
Kolhapur - 416003

Subject: Proposed Directions under Section 33A of Water (Prevention & Control) Act, 1974, 31A of Air (Prevention & Control of Pollution) Act, 1981, and Hazardous Waste (M, H & T) Rules, 2008 as amended reg.

Ref.: Your office letter No. MPCB/RO/KOP/PD/2404250002 dated 25/04/2024

Dear Sir,

With respect to above mentioned reference, submitting the compliance in respect of our Rowale Bauxite Mines TQ Dapoli, District Ratnagiri for your kind perusal.

- As observed during the visit, the reclamation of mined out pit is going on and this will be completed before the onset of monsoon and subsequently the backfilled area will be planted with local species.
- We have made, proper dust suppression arrangements to spray the water in the mining, haul road, stocking area, and loading and unloading area. Please find enclosed photographs for your kind perusal. The backfilled area is planted with cashew saplings and are bearing the fruits which is the evidence that the plants are self-sustaining. Please find enclosed photographs for your kind perusal. Till date we have planted about 19,098 cashew saplings at this mine.
- Mobile crushing unit is not in operation currently.
- The mining activity is carried out by using rock breakers in a small area and proper dust suppression arrangements are made.
- We have provided 04 Nos of AAQM stations as per EC conditions and Air, Water, Noise and Soil monitoring is carried out in time. The analysis reports are attached for your kind perusal.
- As on 31/03/2023, 26.20 Ha land is backfilled and out of which 9.26 Ha is fully re habilitated and Reclamation and Rehabilitation is implemented as per approved Mining Plan and Progressive Mine Closure Plan by Indian Bureau of Mines. Occupational Health checkup of persons engaged in the mining and allied activities is being carried out as stipulated by Director General of Mines Safety. Current RL of working is 214M AMSL. There are no natural water

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Jeevan Udyog Building, 3rd Floor, 278, D. N. Road, Fort, Mumbai - 400 001. (India)
Tel.: +91-22 6665 1700 • Email: info@ashapura.com • www.ashapura.com

CIN No. L14108MH1982PLC026396

ASHAPURA

courses within the mining lease and hence the damage to natural water course does not arise. However, garland trenches, parapet walls, and check dams are constructed to prevent surface run off during the monsoon season wherever required. The vehicles engaged in ore transportation are having the valid PUC certificate and fully covered with tarpaulin to prevent air pollution. The plants within the mining lease are bearing the fruits and this indicates that our mining activity does not affect surrounding crop productivity. Please find attached photographs for your kind perusal.

- Our failure to submit the reply/compliance to SCN dated 02/01/2024 is not deliberate as we have not received the SCN either by mail or post. We would have filed our say had we received the same.

The mine is located well away from the places of human habitat and no imminent danger is associated or envisaged due to mining in the area. We here by request your kind self to accept the compliance and not to initiate any action under Section 33A of Water (Prevention & Control) Act, 1974, 31A of Air (Prevention & Control of Pollution) Act, 1981, and Hazardous Waste (M, H & T) Rules, 2008 as amended and oblige.

Thanking you,

For M/s Ashapura Minechem Ltd.

Authorized Signatory

Cc. The Sub Regional Officer, MPC Board, Chiplun

Gaheli Environmental Laboratory

(A unit of Gaheli Center of Research and Development Pvt. Ltd.)

(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company)

Circuit House Road, Near Parwani Orthopadic Hospital, New Paradise Fountain Circle,
Porbandar - 360575, Gujarat, E-mail - contact@gcrdindia.com, website - www.gcrdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10-002
Issued To: Rowale Bauxite Mine
Village – Rowale, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Haulage Road
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : **24 Hours**

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3,	NO_2,µg/m3	*Silica, µg/m3
	GEL/LAB/ SOP/AIR /01	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6	EPA method/ XRD method
02.03.2024	36.1	81.0	7.0	12.0	0.02
06.03.2024	37.4	79.2	5.3	15.6	0.02
09.03.2024	40.6	81.1	5.1	12.4	0.03
13.03.2024	41.3	79.0	5.4	12.5	0.02
16.03.2024	41.2	83.4	6.0	13.5	0.03
20.03.2024	39.3	81.3	6.4	12.6	0.02
23.03.2024	38.4	78.2	7.3	13.1	0.03
27.03.2024	38.3	85.2	5.0	17.4	0.01
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**	--

'' This parameters is not under NABL Scope.*

End of Report

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

Authorized Signatory
Varsha Pandey
(Managing Director)

Serial No.: 5162

ISO 9001:2015 QUALITY | ISO 14001:2015 ENVIRONMENT | OHSAS 18001:2007 Safety and health at work

Dispatch Date: 10.04.2024
Dispatch No.: 5162

Gaheli Environmental Laboratory

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(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company)

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Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10-003
Issued To: Rowale Bauxite Mine
Village – Rowale, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Kavdoli Village
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : **24 Hours**

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3,	NO_2,µg/m3
	GEL/LAB/SOP/AIR /03	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6
03.03.2024	37.3	79.4	5.3	12.0
07.03.2024	35.5	76.2	6.2	13.1
10.03.2024	35.2	72.1	4.2	13.9
14.03.2024	35.1	72.3	4.3	11.4
17.03.2024	35.3	75.5	4.3	14.0
21.03.2024	36.3	73.2	6.1	15.1
24.03.2024	37.5	72.6	5.2	12.2
28.03.2024	36.0	81.0	6.3	11.0
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**
Protocol	**GEL/LAB/SOP/AIR /03**	**IS 5182 (Part 23): 2006, RA 2017**	**IS 5182 (Part 2): 2001, RA 2017**	**IS 5182 (Part 6): 2006, RA 2017**

End of Report

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

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Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10-004
Issued To: Rowale Bauxite Mine
Village – Rowale, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/0047/2024**
Sampling Location : Mining Pit
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : **24 Hours**

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3	NO_2 ,µg/m3	*Silica, µg/m3
	GEL/LAB/ SOP/AIR /01	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6	EPA method/ XRD method
01.03.2024	33.6	72.0	6.5	11.2	0.01
04.03.2024	35.3	80.2	5.1	14.3	0.03
08.03.2024	37.1	72.4	6.2	12.2	0.01
11.03.2024	34.4	74.2	4.6	14.2	0.02
16.03.2024	32.1	75.2	4.0	12.9	0.02
19.03.2024	32.3	64.8	5.1	11.2	0.01
21.03.2024	33.4	78.1	7.0	11.3	0.02
25.03.2024	37.6	80.1	7.3	11.2	0.03
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**	--

'' This parameters is not under NABL Scope.*

End of Report

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

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Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10-005
Issued To: Rowale Bauxite Mine
Village – Rowale, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Rowale Village
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : **24 Hours**

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3,	NO_2,µg/m3
	GEL/LAB/SOP/AIR /01	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6
02.03.2024	35.3	74.0	6.0	11.2
05.03.2024	37.2	77.2	5.6	14.5
09.03.2024	37.5	76.0	7.1	12.2
11.03.2024	36.3	76.6	6.0	13.6
16.03.2024	38.3	79.0	4.4	12.2
22.03.2024	36.2	74.5	6.0	14.7
23.03.2024	34.5	68.0	4.5	13.2
26.03.2024	36.2	81.5	5.0	13.2
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**

End of Report

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

Authorized Signatory
Varsha Pandey
(Managing Director)

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Porbandar - 360575, Gujarat, E-mail - contact@gcrdindia.com, website - www.gcrdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10- 006
Issued To: Rowale Bauxite Mine
Village – Rowale, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Umbershet Village
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : **24 Hours**

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3,	NO_2,µg/m3
	GEL/LAB/SOP/AIR /01	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6
03.03.2024	39.5	81.7	6.4	12.0
05.03.2024	37.3	79.4	6.0	14.5
11.03.2024	35.4	79.2	7.0	12.1
14.03.2024	38.2	80.1	6.4	14.3
14.03.2024	35.3	77.3	7.4	13.6
22.03.2024	37.4	75.1	6.5	15.0
24.03.2024	35.3	78.5	7.0	10.2
27.03.2024	37.0	76.5	7.0	12.0
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**

End of Report*

TRUE COPY ADVOCATE

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

Authorized Signatory
Varsha Pandey
(Managing Director)

Serial No.: 5166

ISO 9001:2015 QUALITY | ISO 14001:2015 ENVIRONMENT | OHSAS 18001:2007 Safety and health at work

Dispatch Date: 10.04.2024

Dispatch No.: 5166

ANNEXURE-R-4

BEFORE THE NATIONAL GREEN TRIBUNAL, WZ, PUNE
ORIGINAL APPLICATION NO 165 OF 2024

Bhavesh Karekar ....Applicant

Vs

MoEF and CC and Others .... Respondents

REPORT IN COMPLIANCE OF HON'BLE TRIBUNAL ORDER DATED 7.8.2024

1. It is submitted that the Board has granted renewal of consent to operate u/s 26 of the Water (Prevention and Control of Pollution) Act, 1974 & u/s 21 of the Air (Prevention and Control of Pollution) Act, 1981 and Authorization under Rule 6 and Rule 18(7) of the Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016 to M/s Ashapura Minechem Limited, Plot No 66-12-,163-171, 212-216, 770-772,785-786, 788-784, Village Umbershet, Tal Dapoli, Dist-Ratnagiri vide letter dated 22.9.2023 which is valid for a period upto 30.4.2026. A copy of said consent to operate dated 22.9.2023 is enclosed and marked as an **Annexure I.**

2. It is submitted that the Respondent Board has issued warning notice to M/s Ashapura MineChem vide letter dated 2.1.2024. The Industry has not replied to the said Show cause notice. Therefore, the Respondent Board has issued Proposed direction u/s 33 A of Water (Prevention & Control of Pollution) Act, 1974, 31 A of Air (Prevention & Control of Pollution) Act, 1981 & Hazardous Waste (M,H & T) Rules, 2008 as amended. A copy of said Proposed Direction dated 25.4.2024 is enclosed and marked as an **Annexure III.** The Industry has submitted reply to the said Proposed Direction stating various steps taken by them. A copy of said reply is enclosed and marked as an "**Annexure IV**".

3. It is submitted that at present the mining activities of the industry is not in operation due to rainy season. A copy of email received from SRO Chiplun dated 19.8.2024 is enclosed and marked as **Annexure V.**

(Sanjay Jirapure)
Sub Regional Officer-Chiplun

Annexure +

MAHARASHTRA POLLUTION CONTROL BOARD

Tel: 24010706/24010437
Fax: 24044532/4024068/4023516
Website: http://mpcb.gov.in
Email: jdair@mpcb.gov.in

Kalpataru Point, 2nd and 4th floor, Opp. Cine Planet Cinema, Near Sion Circle, Sion (E), Mumbai-400022

RED/S.S.I (R35)
No:- Format1.0/APAE Section/UAN No.MPCB-CONSENT-0000168854/CR/2309001685

Date: 22/09/2023

To,
M/s. Ashapura Minchem Limited
66-120, 163-171, 212-216, 770-772, 785-786, 788-884, Village- Umbershet
Tal - Dapoli, Dist - Ratnagiri

LiFE Lifestyle for Environment
लोकसेवा हक्क कायदा Right to Public Service Act
Your Service is Our Duty

Sub: Grant of Renewal of Consent to Operate under Red category.

Ref: Earlier Consent to Operate granted by the Board vide Consent No. APAE Section / UAN No. 0000110644 / CR / CC - 0399 dtd. 07/12/2021.

Your application No.MPCB-CONSENT-0000168854 Dated 20.04.2023

For: Grant of Consent to Operate under Section 26 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization under Rule 6 and Rule 18(7) of the Hazardous & Other Wastes (Management & Transboundary Movement) Rules 2016 is considered and the consent is hereby granted subject to the following terms and conditions and as detailed in the schedule I, II, III & IV annexed to this order:

1. **The consent to renewal is granted for a period up to 30/04/2026**
2. **The capital investment of the project is Rs.3.0 Crs. (As per C.A Certificate submitted by industry)**
3. **Consent is valid for the manufacture of:**

Sr No	Product	Maximum Quantity	UOM
Products			
1	Bauxite Ore (Mining lease area of 99.8619 hectares)	500000	MT/A

4. **Conditions under Water (P&CP), 1974 Act for discharge of effluent:**

Sr No	Description	Permitted (in CMD)	Standards to	Disposal Path
1.	Trade effluent	0	As per Schedule-I	Not Applicable
2.	Domestic effluent	2.4	As per Schedule-I	On land for gardening

5. **Conditions under Air (P& CP) Act, 1981 for air emissions:**

Sr No.	Stack No.	Description of stack / source	Number of Stack	Standards to be achieved
1	0	NA	0	As per Schedule -II

6. **Non-Hazardous Wastes:**

Sr No	Type of Waste	Quantity	UoM	Treatment	Disposal
1	Waste Bauxite Ore Mineral	0.56	MTPA	Sale	Sale to authorized party

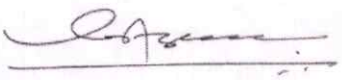
7. **Conditions under Hazardous & Other Wastes (M & T M) Rules 2016 for Collection, Segregation, Storage, Transportation, Treatment and Disposal of hazardous waste:**

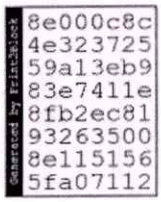
Sr No	Category No./ Type	Quantity	UoM	Treatment	Disposal
NA					

Industry shall not generate any Hazardous Waste.

8. The Board reserves the right to review, amend, suspend, revoke etc. this consent and the same shall be binding on the industry.
9. This consent should not be construed as exemption from obtaining necessary NOC/permission from any other Government authorities
10. The applicant shall comply with the conditions of the Environmental Clearance granted by MoEF vide letter F. No.J-11015/418/2013-IA-II(M) dtd. 24/02/2016.
11. PP shall carry out plantation as per EC condition before ensuing monsoon.
12. PP shall provide treatment plant for mine water discharge and submit sedimentation tank design details.
13. PP shall comply with the conditions stipulated in NOC issued by Central Ground Water Authority vide dtd. 08/12/2019 valid upto 07/12/2021 and shall obtain renewal of same time to time.
14. The applicant shall extend all existing BGs towards O&M of pollution control systems and towards compliance of the Consent conditions.
15. This consent is granted without prejudice of the order passed or being passed by the Hon'ble National Green Tribunal (WZ) Pune for the case No. 74 of 2016.
16. It is obligatory on the part of the Project proponent to restrict the mining operations above ground water table & it should not intersect ground water table without obtaining prior approval of MoEF & Climate Change, GoI & Central Ground Water Authority for mining below water table.
17. PP shall provide minimum four ambient air quality monitor stations within area within period of Six months which should monitor the parameters such as SPM, RSPM, SO2, NOx, HC, CO etc. to conform to the National Ambient Air Quality Standards prescribed under Air (Prevention and Control of Pollution) Act, 1981 and Environment (Protection) Act, 1986. Bank Guarantee of Rs.2/- lakhs shall be submitted within 15 days towards the compliance of the same.
18. PP shall inform to the Board before starting mining operations and Regional Officer shall ensure the compliances of consent conditions and Pollution Control Systems provided by industry and submit the compliance report.

19. The applicant shall not carry out any excess excavation without obtaining Consent of the Board and without obtaining Environmental Clearance wherever it applicable.
20. The applicant shall make an application for Renewal of Consent 60 days prior to date of expiry of the Consent.





Signed by: Dr. V.M.Motghare
Joint Director (Air Pollution Control)
For and on behalf of,
Maharashtra Pollution Control Board
jdair@mpcb.gov.in
2023-09-22 14:48:30 IST

Received Consent fee of -

Sr.No	Amount(Rs.)	Transaction/DR.No.	Date	Transaction Type
1	75000.00	TXN2304003965	01/05/2023	Online Payment
2	400000.00	TXN2309002310	14/09/2023	Online Payment

As per Consent granted vide dated 07/12/2021 balance fees was Rs. 2,15,000/- and same is considered During this Renewal. Fees of Rs. 30000/- from the above mentioned fees is balance with the Board and same will be considered during next Renewal of Consent.

Copy to:

1. Regional Officer, MPCB, Kolhapur and Sub-Regional Officer, MPCB, Chiplun
   - They are directed to ensure the compliance of the consent conditions.
2. Chief Accounts Officer, MPCB,Sion, Mumbai

SCHEDULE-I

Terms & conditions for compliance of Water Pollution Control:

1. A] Generation - As per your application the treated effluent generation is Nil.
   B] Treatment - NA
   C] Disposal - NA

2. A] As per your application, you have provided Septic Tank followed by Soak pit for the treatment of 2.4 CMD of sewage.

   B] The Applicant shall operate the sewage treatment system to treat the sewage so as to achieve the following standards.

Sr.No	Parameters	Standards (mg/l)	
1	BOD (3 days 27°C)	Not to exceed	30
2	Suspended Solids	Not to exceed	50

   C] The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

3. The Board reserves its rights to review plans, specifications or other data relating to plant setup for the treatment of waterworks for the purification there of & the system for the disposal of sewage or trade effluent or in connection with the grant of any consent conditions. The Applicant shall obtain prior consent of the Board to take steps to establish the unit or establish any treatment and disposal system or an extension or addition thereto.

4. The industry shall ensure replacement of pollution control system or its parts after expiry of its expected life as defined by manufacturer so as to ensure the compliance of standards and safety of the operation thereof.

5. The Applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Act, 1974 and as amended, by installing water meters and other provisions as contained in the said act:

Sr. No.	Purpose for water consumed	Water consumption quantity (CMD)
1.	Industrial Cooling, spraying in mine pits or boiler feed	60.00
2.	Domestic purpose	8.00
3.	Processing whereby water gets polluted & pollutants are easily biodegradable	0.00
4.	Processing whereby water gets polluted & pollutants are not easily biodegradable and are toxic	0.00
5.	Gardening	12

6. The Applicant shall provide Specific Water Pollution control system as per the conditions of EP Act, 1986 and rule made there under from time to time/ Environmental Clearance/ CREP guidelines.

SCHEDULE-II

Terms & conditions for compliance of Air Pollution Control:

1. As per your application, you have provided the Air pollution control (APC) system and erected following stack (s) to observe the following fuel pattern:

Stack No.	Source	APC System provided/proposed	Stack Height(in mtr)	Type of Fuel	Sulphur Content(in %)	Pollutant	Standard
0	NA		0.00	-	-	TPM	150 Mg/Nm^3

2. The Applicant shall provide Specific Air Pollution control equipments as per the conditions of EP Act, 1986 and rule made there under from time to time/ Environmental Clearance / CREP guidelines.
3. The Applicant shall obtain necessary prior permission for providing additional control equipment with necessary specifications and operation thereof or alteration or replacement/alteration well before its life come to an end or erection of new pollution control equipment.
4. The Board reserves its rights to vary all or any of the condition in the consent, if due to any technological improvement or otherwise such variation (including the change of any control equipment, other in whole or in part is necessary).
5. Control Equipments
   a. Scientific spraying of water on all working area, dump area, stock piles with the help of appropriate dust suppression system.
   b. Minerals shall be properly covered during transportation.
   c. The applicant shall carry out tree plantation along road side, around dumps or compulsory afforestation as per proposal approved by Forest Department. The tree plantation programme shall be taken up well in advance of the actual mining activity, so that green belt of sufficient width & height is developed between mining area/road and surrounding environment.
   d. Black topped metal roads provided shall be well maintained to prevent dust formation.
   e. Overloading of dumpers shall be avoided to prevent spillages.
   f. Correct type & quantity of explosive shall be used to avoid excess dust formation & vibration in the surrounding area.
   g. The slope of the over burden shall have slope not more than 28° to the horizontal. The overburden shall be properly covered by vegetation for stabilization.
   h. Bauxite Ore / Minerals transportation shall be done by installing conveyors wherever possible & mechanically covered closed trucks shall be used for transportation.
   i. Dust containment-cum-suppression system for the equipment.

6. Standards for Ambient Air Pollutants:

The Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_x) concentration in downwind direction considering predominant wind direction, at a distance of 500 metres from the following dust generating sources shall not exceed the standards specified in the table given below:

Dust Generating Sources:

Loading or unloading, Haul Road, coal transportation road, Coal handling plant (CHP), Railway Sliding, Blasting, Drilling, Overburden dumps, or any other dust generating external sources like coke ovens (hard as well as soft), briquette industry, nearby road etc.

Pollutant	***Time weighted average***	***Concentration in Ambient Air***
Suspended Particulates Matter (SPM)	Annual Average	360 µg/m^3
	24 hours	500 µg/m^3
Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average	180 µg/m^3
	24 hours	250 µg/m^3
Sulphur Dioxide (SO_2)	Annual Average	80 µg/m^3
	24 hours	120 µg/m^3
Oxides of Nitrogen as NO_x	Annual Average	80 µg/m^3
	24 hours	120 µg/m^3

i. In case of any residential or commercial or industrial place falls within 500 metres of any dust generating sources, the National Ambient Air Quality Standards notified vide MOEFCC GOI notification dtd 16.11.2009 as ammended shall be made applicable.

ii. The applicant shall provide minimum three ambient air quality monitoring stations within mining area which should be monitored for SPM, RSPM, SO_2, NOx, HC, CO etc. The Annual Arithmetic Mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval shall conform to the National Ambient Air Quality Standards prescribed under Air (Prevention and Control of Pollution) Act, 1981 and Environment (Protection) Act, 1986. The records of results of monitoring done shall be made available for inspection to the officers of the Board.

7. The applicant shall take adequate measures for control of noise levels from its own sources as follows:

Sr. No	***Location***	***Permissible Norms [in dB (A)]***	***Desired minimum thickness of green belt (m)***
1.	Along Road side	65 (Commercial Area)	20
2.	In colonies	55 (Residential Area)	20
3.	Near Opencast Mines	75 (Industrial Area)	10
4.	Near CHPs	75	30
5.	Near Shaft	75	20
6.	Near Mine exhaust fan	75	> 50

8. Other conditions:

i Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess standards laid down, such information shall be forthwith reported to Board, concerned Police station, office of Directorate of Health services, Dept. of explosives, Inspectorate of Factories & Local Body. In case of failure of pollution control equipments, the production process connected to it shall be stopped.

SCHEDULE-III

Details of Bank Guarantees:

Sr. No.	Consent (C2E/ C2O /C2R)	Amt of BG Imposed	Submission Period	Purpose of BG	Compliance Period	Validity Date
1	Renewal of Consent	Rs. 5.0 Lakh	15 days	Towards operation and maintenance of pollution control system and compliance of consent conditions	Continuous	31/08/2026
2	Renewal of Consent	Rs. 2.0 Lakh	15 days	Installation and commissioning of four ambient air quality monitor stations within area	6 Months	31/08/2026

BG Forfeiture History

Srno.	Consent (C2E/C2O/C2R)	Amount of BG imposed	Submission Period	Purpose of BG	Amount of BG Forfeiture	Reason of BG Forfeiture
NA						

BG Return details

Srno.	Consent (C2E/C2O/C2R)	BG imposed	Purpose of BG	Amount of BG Returned
NA				

SCHEDULE-IV

General Conditions:

1. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous waste to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.
2. If the MIDC pipeline is broken/ overflowing chamber, in such cases industry shall not discharge their treated effluent into MIDC drain, it shall be sent to CETP by tanker.
3. Industry should monitor effluent quality, stack emissions and ambient air quality monthly/quarterly.
4. The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.
5. Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipment, the production process connected to it shall be stopped.
6. The applicant shall provide an alternate electric power source sufficient to operate all pollution control facilities installed to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms and conditions of this consent.
7. The firm shall submit to this office, the 30th day of September every year, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as per the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.
8. The industry shall recycle/reprocess/reuse/recover Hazardous Waste as per the provision contain in the H&OW(M&TM) Rules 2016, which can be recycled/processed/ reused/ recovered and only waste which has to be incinerated shall go to incineration and waste which can be used for land filling and cannot be recycled/ reprocessed etc. should go for that purpose, in order to reduce load on incineration and landfill site/environment.
9. The industry should comply with the Hazardous & Other Wastes (M & TM) Rules, 2016 and submit the Annual Returns as per Rule 6(5) & 20(2) of Hazardous & Other Wastes (M & TM) Rules, 2016 for the preceding year April to March in Form-IV by 30th June of every year.
10. An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.
11. The applicant shall make an application for renewal of the consent at least 60 days before the date of the expiry of the consent.
12. Industry shall strictly comply with the Water (P&CP) Act, 1974, Air (P&CP) Act,1981 and Environmental Protection Act,1986 and industry specific standard under EP Rules 1986 which are available on MPCB website(www.mpcb.gov.in).
13. The industry shall constitute an Environmental cell with qualified staff/personnel/agency to see the day to day compliance of consent condition towards Environment Protection.

14. Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of the collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes/sewers downstream of the terminal manholes. No effluent shall find its way other than in designed and provided collection system.
15. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.
16. The applicant shall install a separate meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.
17. Conditions for D.G. Set
    a) Noise from the D.G. Set should be controlled by providing an acoustic enclosure or by treating the room acoustically.
    b) Industry should provide acoustic enclosure for control of noise. The acoustic enclosure/ acoustic treatment of the room should be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on higher side. A suitable exhaust muffler with insertion loss of 25 dB (A) shall also be provided. The measurement of insertion loss will be done at different points at 0.5 meters from acoustic enclosure/room and then average.
    c) Industry should make efforts to bring down noise level due to DG set, outside industrial premises, within ambient noise requirements by proper sitting and control measures.
    d) Installation of DG Set must be strictly in compliance with recommendations of DG Set manufacturer.
    e) A proper routine and preventive maintenance procedure for DG set should be set and followed in consultation with the DG manufacturer which would help to prevent noise levels of DG set from deteriorating with use.
    f) D.G. Set shall be operated only in case of power failure.
    g) The applicant should not cause any nuisance in the surrounding area due to operation of D.G. Set.
    h) The applicant shall comply with the notification of MoEFCC, India on Environment (Protection) second Amendment Rules vide GSR 371(E) dated 17.05.2002 and its amendments regarding noise limit for generator sets run with diesel.
18. The industry should not cause any nuisance in surrounding area.
19. The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB (A) during day time and 70 dB (A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.
20. The applicant shall maintain good housekeeping.
21. The applicant shall bring minimum 33% of the available open land under green coverage/ plantation. The applicant shall submit a yearly statement by 30th September every year on available open plot area, number of trees surviving as on 31st March of the year and number of trees planted by September end
22. The non-hazardous solid waste arising in the factory premises, sweepings, etc. be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal of solid waste.
23. The applicant shall not change or alter the quantity, quality, the rate of discharge, temperature or the mode of the effluent/emissions or hazardous wastes or control equipment provided for without previous written permission of the Board. The industry will not carry out any activity, for which this consent has not been granted/without prior consent of the Board.

24. The industry shall ensure that fugitive emissions from the activity are controlled so as to maintain clean and safe environment in and around the factory premises
25. The industry shall submit official e-mail address and any change will be duly informed to the MPCB.
26. The industry shall achieve the National Ambient Air Quality standards prescribed vide Government of India, Notification dtd. 16.11.2009 as amended.

This certificate is digitally & electronically signed.

Annexure - II

MAHARASHTRA POLLUTION CONTROL BOARD
REGIONAL OFFICE, KOLHAPUR.

Tel. No. (0231) 2652952, 2660448 Fax No. (0231) 2652952. E-mail: rokolhapur@yahoo.com	"Your Service is Our Duty"	Udyog Bhavan, Near Collector Office, Kolhapur - 416 003. Website:http://mpcb.mah.nic.in

No. MPCB/RO/KOP/ 2401020010 Date: 02/01/2024

To,
M/s. Ashapura Minechem Ltd.,
Gut No. 66-120,163 -171, 212 -216, 770-722,
785 -786, 788 – 884, Village - Umbershet,
Tal:- Dapoli , Dist:- - Ratnagiri.

Sub: **Show Cause Notice** for noncompliance of consent conditions.

Ref: 1). Consent granted by the Board and same is valid up to 30/04/2026.
2). Complaint received from Shri. Rahul Shashikant Karekar on 25/10/2023.
3). Visit of Board officials on 06/11/2023.
4). Warning notice issued by SRO Chiplun on 21/11/2023.
5). Proposal submitted by SRO Chiplun.

.....

WHEREAS, you are operating your unit in 'Pollution Prevention Area' declared under Water (Prevention & Control of Pollution) Act, 1974 & Air (Prevention & Control of Pollution) Act, 1981 & Hazardous Waste (Management & TM) Rules, 2008 as amended 2016.

AND WHEREAS, it is obligatory on your part to provide adequate water and air pollution control devices and adequate health and safety & accidental precautionary measures and to operate it round o'clock so as to prevent any sort of pollution in the surrounding area and to achieve the standards laid down under the provisions of Environment (Protection) Act, 1986.

AND WHEREAS, Board Officials visited your unit on 06/11/2023 for investigate complaint received at SRO Chiplun office and to checking the compliance as per consent conditions & as per ref No. (1) & (2) respectively and observed following non compliances.

1). During visit, mining operation was found in progress with only one rock breaker, screening of crush bauxite ore which is not enclosed by tin sheet & truck transportation of the same is in progress.

2). Truck body is covered with green net.

3). As per complainant transit pass receipt (integrated with DMO transit pass) indicating net weight violations not available during visit.

4). During visit details of water tanker receipts was not available.

5). Reclaimed area with cashew plant were observed, you are directed to submit details of area & tree plantations etc.

6). As per points raised in complaint, the following details are not available during visit of board officials and same are as below:-

A). Conservation of Environment.

B). Health & wellbeing of people living in surrounding areas.

C). Mitigating the effect of mining on agriculture productivity in surrounding area.

D). Reclamation & rehabilitation of mined area.

E). Overloading of carrying trucks.

F). Google geographical images for lack of afforestation over the specific time period.

G). Information related to Environmental Clearance obtained on 24/02/2016, detail compliances awaited.

H). Weigh bridge 60 MT provided.

I). Detail information in respect of air pollution control provided & yet not provided by you to board office.

7).You have failed to submit reply to warning notice issued by local board office as per ref. (4).

AND WHEREAS, after examining the record of your case, reports of officers of the Board & making necessary enquiries, I am satisfied that you are causing Environmental Pollution problems in the surrounding area and knowingly & wilfully causing grave injury to the environment thereby violating various Environment enactments.

Your reply/ objection should reach this office within Seven days' time after receipt of this letter. Failure to this, it will be assumed that you have nothing to say and further legal action will be initiated under the provision of Environmental Laws, which may please be noted.

(J. S. Salunkhe)
Regional Officer,
M.P.C. Board, Kolhapur

Copy to:
Sub-Regional Officer, M.P.C.Board, Chiplun.
- He is directed to serve the directions to the above industry and submit the compliance Report along with clear cut remarks accordingly.

MAHARASHTRA POLLUTION CONTROL BOARD
REGIONAL OFFICE, KOLHAPUR.

Tel. No. (0231) 2652952, 2660448
Fax No. (0231) 2652952.
E-mail:
rokolhapur@mpcb.gov.in

"Your Service is Our Duty"

Udyog Bhavan,
Near Collector Office,
Kolhapur - 416 003.
Website:
http://mpcb.mah.nic.in

No. MPCB/RO/KOP/PD/2404250001 Date: 25/04/2024

To,
M/s.Ashapura Minechem ,
S.No.66-120,163-171,212-216,770-772,785-786,788-884
At:- Umbershet , Tal-Dapoli ,
Dist. Ratnagiri.

Sub: Proposed Directions under section 33 A of Water (Prevention & Control of Pollution) Act, 1974, 31 A of Air (Prevention & Control of Pollution) Act, 1981 & Hazardous Waste (M, H & T) Rules, 2008 as amended.

Ref:
1. Consent granted by the board and same is valid up to 30/04/2026.
2. Complaint received from Sarpanch, Group Grampanchayat, Umbarshet and also Shri, Bhavesh Karekar, regarding Violations of compliance conditions.
3. Visit of Board Officials to your unit on 08/04/2024.
4. This office has issued SCN dtd., 02/01/2024.
5. Proposal submitted by SRO Chiplun.

.....

WHEREAS, you are operating your unit in 'Pollution Prevention Area' declared under Water (Prevention & Control of Pollution) Act, 1974 & Air (Prevention & Control of Pollution) Act, 1981 & Hazardous Waste (Management & TM) Rules, 2008 as amended 2016.

AND WHEREAS, it is obligatory on your part to obtain valid consent from the Board for appropriate activity and to provide adequate water and air pollution control devices and adequate health and safety & accidental precautionary measures and to operate it round o'clock so as to prevent any sort of pollution in the surrounding area and to achieve the standards laid down under the provisions of Environment (Protection) Act, 1986.

AND WHEREAS, Board Officials visited your unit on 08/04/2024 and observed following non-compliance: -

1). During visit it was observed that you are carrying out bauxite Mining activity and same is found in operation.

2). You have not provided water spraying system to the mining area, haul roads, & fine dust/ material storage, loading & unloading area etc. Regular water spraying is not carried out. The backfilled area is not reclaimed by planting adequate no of trees. The prima facie it seems that the backfilled area is not properly restored to the normal ground level and also self-sustaining vegetation were not observed in this area. Adequate tree plantation is not carried out in the specified area, reclaimed area, and roads etc.

3). You have provided 03 nos of movable crushers, conveyors and screening sections however you have not covered the same.

4). You have not taken preventive measures for control of dust emissions. The dust emissions were observed from the excavation activity of mining and crushing activity.

5). You have not provided 04 nos of AAQM stations with consultation of the Board.

6). You are instructed to submit details of backfilled area and plantation carried out in last two years, natural water courses obstructed in mining area, check-ups of occupational health of engaged workers and also details of preventive measures & vehicles transportation, and effect on surrounding crop productivity,

7). You have failed to submit reply / compliance of SCN issued to your unit dtd., 02/01/2024, and also submit compliance of Bank Guarantee, Consent conditions and E.C. to the board.

AND WHEREAS, after examining the record of your case, reports of officers of the Board & making necessary enquiries, I am satisfied that you are causing Environmental Pollution problems in the surrounding area and knowingly & wilfully causing grave injury to the environment thereby violating various Environment enactments.

NOW THEREFORE, in exercise of the powers conferred on the undersigned by the Board under section 33A of the by the Water (Prevention & Control of Pollution) Act, 1974 and section 31A of Air (Prevention & Control of Pollution) Act, 1981 it is proposed to issue the following directions (for avoidance of doubt, the directions include closure, prohibition or regulation of your activities).

I) Why your industry shall not be closed down forthwith?

II) Why competent authorities shall not be directed to disconnect your water/electricity supply till you comply with the provisions of the said Acts?

You are directed to file your reply to these directions, within Seven days from the receipt of this notice, failing which Board shall consider issuance of appropriate legal action as may be deemed fit in your case, which may please be noted.

FOR AND ON BEHALF OF THE BOARD

(J. S. Salunkhe)
Regional Officer,
M.P.C. Board, Kolhapur

Copy submitted for information.
1) Member Secretory, M.P.C. B, Mumbai.
2) Joint Director (Air Pollution Control) Mumbai.

Copy to:
Sub-Regional Officer, M.P.C.Board, Chiplun
- He is directed to serve the directions to the above industry and submit the Practical compliance report along with clear cut remarks accordingly within stipulated period.

Annexure IV

ASHAPURA
MINECHEM LIMITED

To:

Date: 30.04.2024

The Regional Officer,
Maharashtra State Pollution Control Board
Regional Office, Kolhapur
Udyog Bhavan,
Near Collector Office,
Kolhapur - 416003

Subject: Proposed Directions under Section 33A of Water (Prevention & Control) Act, 1974, 31A of Air (Prevention & Control of Pollution) Act, 1981, and Hazardous Waste (M, H & T) Rules, 2008 as amended reg.

Ref.: Your office letter No. MPCB/RO/KOP/PD/2404250001 dated 25/04/2024

Dear Sir,

With respect to above mentioned reference, submitting the compliance in respect of our Umbershet Bauxite Mines TQ Dapoli, District Ratnagiri for your kind perusal.

- As observed during the visit, the reclamation of mined out pit is going on and this will be completed before the onset of monsoon and subsequently the backfilled area will be planted with local species.
- We have made, proper dust suppression arrangements to spray the water in the mining, haul road, stocking area, and loading and unloading area. Please find enclosed photographs for your kind perusal. The backfilled area is planted with cashew saplings and are bearing the fruits which is the evidence that the plants are self-sustaining. Please find enclosed photographs for your kind perusal. Till date we have planted about 12,682 cashew saplings at this mine.
- Mobile crushing unit is not in operation currently.
- The mining activity is carried out by using rock breakers in a small area and proper dust suppression arrangements are made.
- We have provided 04 Nos of AAQM stations as per EC conditions and Air, Water, Noise and Soil monitoring is carried out in time. The analysis reports are attached for your kind perusal.
- As on 31/03/2023, 14.22 Ha land is backfilled and out of which 3.22 Ha is fully re habilitated and Reclamation and Rehabilitation is implemented as per approved Mining Plan and Progressive Mine Closure Plan by Indian Bureau of Mines. Occupational Health checkup of persons engaged in the mining and allied activities is being carried out as stipulated by Director General of Mines Safety. Current RL of working is 179M AMSL. There are no natural water

Regd. Office :
Jeevan Udyog Building, 3rd Floor, 278, D. N. Road, Fort, Mumbai - 400 001. (India)
Tel.: +91-22 6665 1700 • Email: info@ashapura.com • www.ashapura.com

CIN No. L14108MH1982PLC026396

Continuation Sheet

ASHAPURA

courses within the mining lease and hence the damage to natural water course does not arise. However, garland trenches, parapet walls, and check dams are constructed to prevent surface run off during the monsoon season wherever required. The vehicles engaged in ore transportation are having the valid PUC certificate and fully covered with tarpaulin to prevent air pollution. The plants within the mining lease are bearing the fruits and this indicates that our mining activity does not affect surrounding crop productivity. Please find attached photographs for your kind perusal.

- Our failure to submit the reply/compliance to SCN dated 02/01/2024 is not deliberate as we have not received the SCN either by mail or post. We would have filed our say had we received the same.

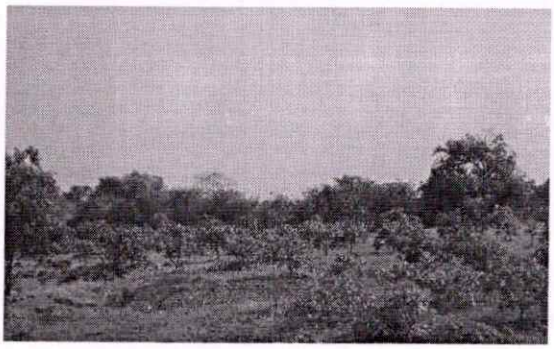
The mine is located well away from the places of human habitat and no imminent danger is associated or envisaged due to mining in the area. We here by request your kind self to accept the compliance and not to initiate any action under Section 33A of Water (Prevention & Control) Act, 1974, 31A of Air (Prevention & Control of Pollution) Act, 1981, and Hazardous Waste (M, H & T) Rules, 2008 as amended and oblige.

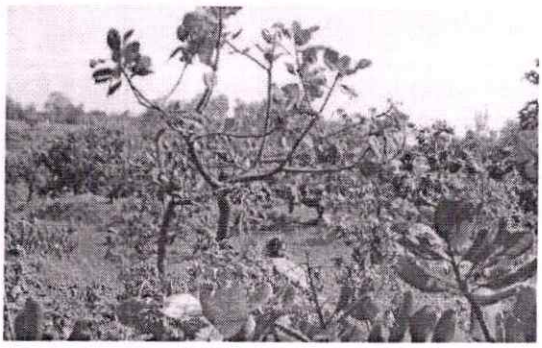
Thanking you,

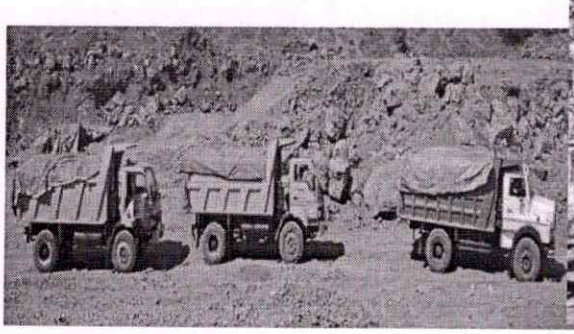
For M/s Ashapura Minechem Ltd.

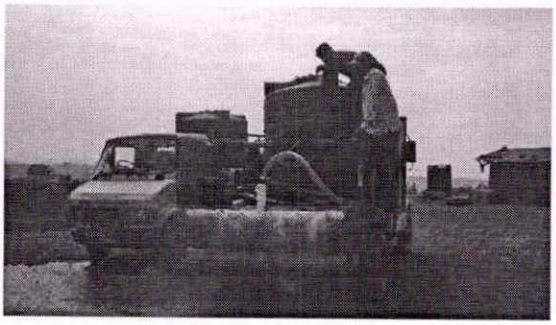
Authorized Signatory

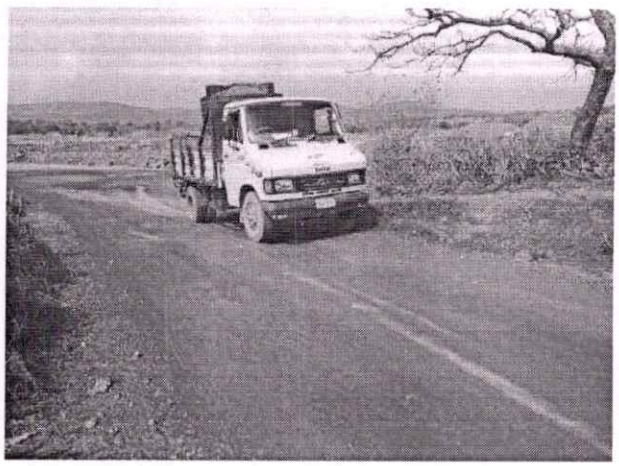
Cc. The Sub Regional Officer, MPC Board, Chiplun

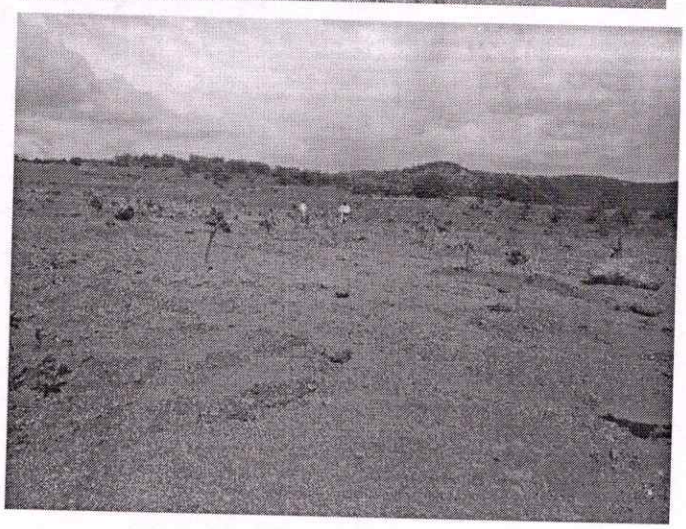


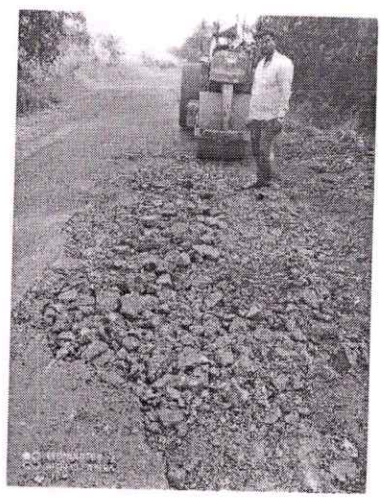


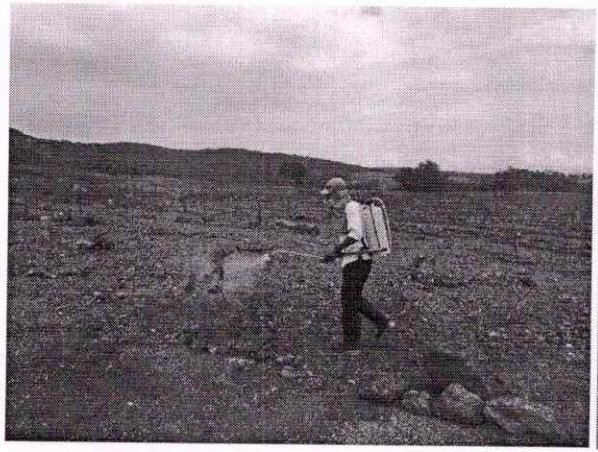


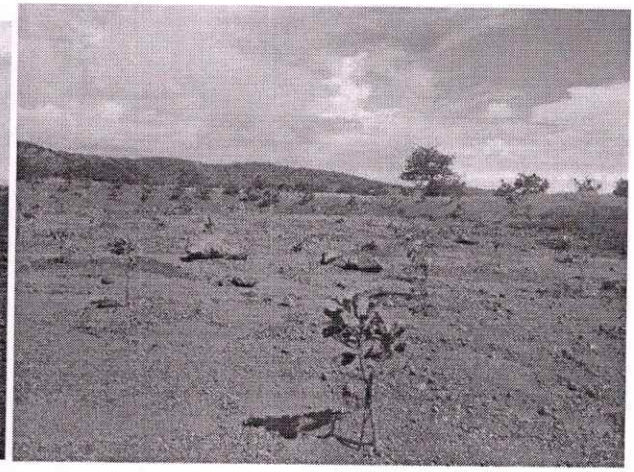


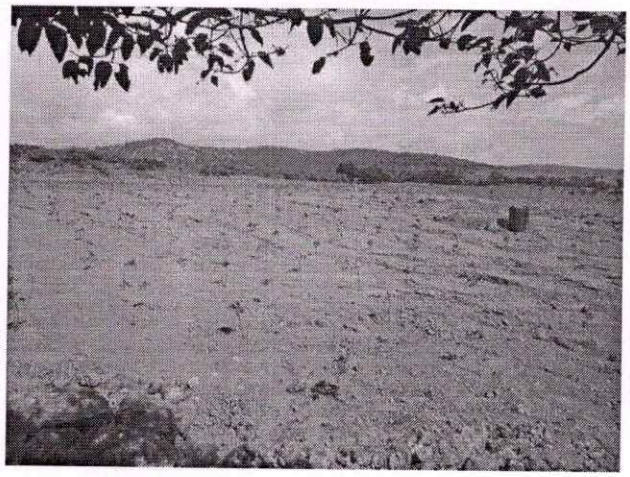


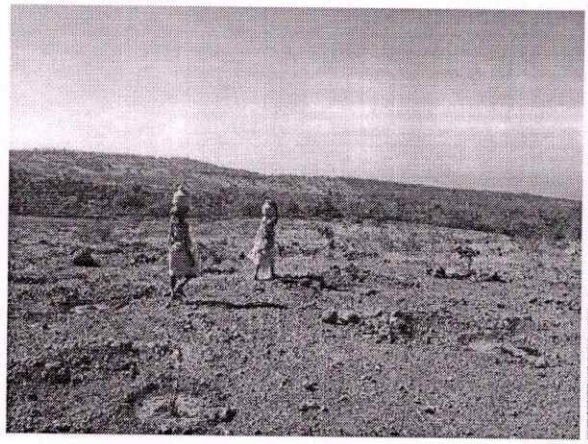


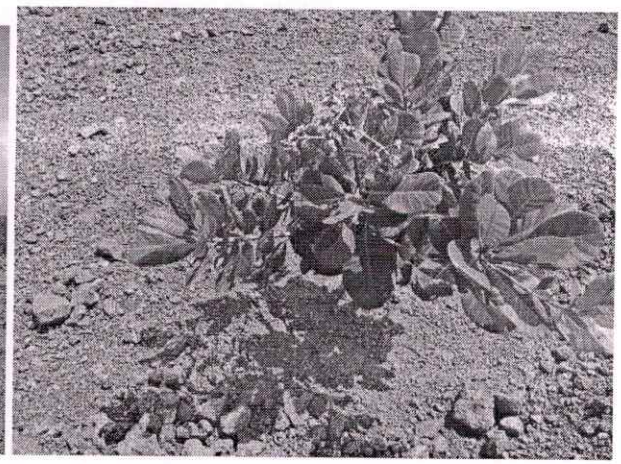












Gaheli Environmental Laboratory

(A unit of Gaheli Center of Research and Development Pvt. Ltd.)

(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company)

Circuit House Road, Near Parwani Orthopadic Hospital, New Paradise Fountain Circle,
Porbandar - 360575, Gujarat, E-mail - contact@gcrdindia.com, website - www.gcrdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10- 001
Issued To: Umbershet Bauxite Mine
Village – Umbershet, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Crushing Plant
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : 24 Hours

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3 ,	NO_2 ,µg/m3	*Silica, µg/m3
	GEL/LAB/ SOP/AIR /03	**IS:5182:Pt-23**	**IS:5182:Pt-2**	**IS:5182:Pt-6**	**EPA method/ XRD method**
01.03.2024	39.6	80.1	8.2	13.2	0.03
04.03.2024	37.4	88.5	5.3	12.2	0.02
08.03.2024	39.7	84.0	8.5	13.2	0.01
11.03.2024	40.4	82.2	11.0	12.4	0.03
16.03.2024	39.2	82.0	9.0	13.8	0.03
19.03.2024	42.1	90.1	10.5	14.5	0.03
23.03.2024	43.4	80.4	6.0	13.6	0.02
27.03.2024	41.3	83.3	10.1	10.4	0.02
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**	**--**

'' This parameters is not under NABL Scope.*

End of Report

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

Authorized Signatory
Varsha Pandey
(Managing Director)

Serial No.: S197

ISO 9001:2015 QUALITY | ISO 14001:2015 ENVIRONMENT | OHSAS 18001:2007 Safety and health

Dispatch Date: 10.04.202

Dispatch No.: S197

Gaheli Environmental Laboratory

(A unit of Gaheli Center of Research and Development Pvt. Ltd.)

(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company)

Circuit House Road, Near Parwani Orthopadic Hospital, New Paradise Fountain Circle,
Porbandar - 360575, Gujarat, E-mail - contact@gcrdindia.com, website - www.gcrdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10-002
Issued To: Umbershet Bauxite Mine
Village – Umbershet, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Haulage Road
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : 24 Hours

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3,	NO_2 ,µg/m3	*Silica, µg/m3
	GEL/LAB/ SOP/AIR/01	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6	EPA method/ XRD method
02.03.2024	41.0	83.0	8.0	11.8	0.02
05.03.2024	38.2	82.3	7.2	12.4	0.01
09.03.2024	41.3	81.4	9.2	14.4	0.01
14.03.2024	37.4	78.8	9.3	16.2	0.02
16.03.2024	40.0	84.0	9.8	11.1	0.02
20.03.2024	38.8	79.1	6.7	12.5	0.03
25.03.2024	42.4	85.4	6.5	13.8	0.02
27.03.2024	40.1	78.6	6.0	11.0	0.02
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**	–

'' This parameters is not under NABL Scope.*

End of Report

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

Authorized Signatory
Varsha Pandey
(Managing Director)

Gaheli Environmental Laboratory

(A unit of Gaheli Center of Research and Development Pvt. Ltd.)

(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company)

Circuit House Road, Near Parwani Orthopadic Hospital, New Paradise Fountain Circle,
Porbandar - 360575, Gujarat, E-mail - contact@gcrdindia.com, website - www.gcrdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10-003
Issued To: Umbershet Bauxite Mine
Village – Umbershet, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : 10/04/2024
Sampling Location : Kavdoli Village
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : 24 Hours

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3	NO_2 µg/m3
	GEL/LAB/SOP/AIR /03	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6
03.03.2024	36.0	80.4	5.0	10.2
05.03.2024	36.5	76.2	6.1	12.1
10.03.2024	36.2	72.1	4.2	13.9
13.03.2024	34.0	72.3	4.1	12.4
17.03.2024	35.3	73.5	4.0	13.3
20.03.2024	37.4	72.2	5.1	15.1
24.03.2024	37.0	70.6	5.2	10.2
27.03.2024	36.7	81.2	5.0	11.0
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**
Protocol	**GEL/LAB/SOP/AIR /03**	**IS 5182 (Part 23): 2006, RA 2017**	**IS 5182 (Part 2): 2001, RA 2017**	**IS 5182 (Part 6): 2006, RA 2017**

End of Report

GAHELI ENVIRONMENTAL LABORATORY PORBANDAR

Authorized Signatory
Varsha Pandey
(Managing Director)

Gaheli Environmental Laboratory

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Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10- 004
Issued To: Umbershet Bauxite Mine
Village – Umbershet, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Mining Pit
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : **24 Hours**

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3,	NO_2,µg/m3	*Silica, µg/m3
	GEL/LAB/ SOP/AIR /03	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6	EPA method/ XRD method
01.03.2024	38.0	80.6	7.0	15.0	0.02
06.03.2024	39.5	82.5	5.5	13.2	0.02
07.03.2024	36.3	77.0	8.6	14.3	0.03
12.03.2024	36.0	70.1	6.1	16.2	0.02
16.03.2024	40.6	73.6	8.0	13.0	0.02
19.03.2024	35.2	77.0	6.6	15.3	0.02
22.03.2024	38.1	82.2	6.6	13.4	0.01
27.03.2024	39.0	80.0	7.1	14.0	0.03
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**	–

'' This parameters is not under NABL Scope.*

End of Report*

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

Authorized Signatory
Varsha Pandey
(Managing Director)

Serial No.: 5200

ISO 9001:2015 QUALITY | ISO 14001:2015 ENVIRONMENT | OHSAS 18001:2007 Safety and health

Dispatch Date: 10.04.20

Dispatch No.: 5200

Gaheli Environmental Laboratory

(A unit of Gaheli Center of Research and Development Pvt. Ltd.)

(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company)

Circuit House Road, Near Parwani Orthopadic Hospital, New Paradise Fountain Circle,
Porbandar - 360575, Gujarat, E-mail - contact@gcrdindia.com, website - www.gcrdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10-005
Issued To: Umbershet Bauxite Mine
Village – Umbershet, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Rowale Village
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : **24 Hours**

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3,	NO_2,µg/m3
	GEL/LAB/SOP/AIR /01	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6
02.03.2024	37.7	71.0	6.4	11.0
05.03.2024	37.5	76.2	5.0	14.5
09.03.2024	38.4	78.4	7.1	11.2
12.03.2024	35.1	77.6	6.0	13.5
16.03.2024	38.2	79.0	5.4	12.1
21.03.2024	35.0	77.5	5.5	14.7
24.03.2024	33.5	68.3	6.5	13.1
28.03.2024	34.0	78.0	6.0	13.0
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**

End of Report*

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

Authorized Signatory
Varsha Pandey
(Managing Director)

Serial No.: S201

ISO 9001:2015 QUALITY | ISO 14001:2015 ENVIRONMENT | OHSAS 18001:2007 Safety and health

Dispatch Date: 10.04.202

Dispatch No.: S201

Gaheli Environmental Laboratory

(A unit of Gaheli Center of Research and Development Pvt. Ltd.)

(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company)

Circuit House Road, Near Parwani Orthopadic Hospital, New Paradise Fountain Circle,
Porbandar - 360575, Gujarat, E-mail - contact@gcrdindia.com, website - www.gcrdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, **GSTIN : 24AHCPA6690B1ZV**

TEST REPORT

Report Code: GEL/A/2024/04/10-006
Issued To: Umbershet Bauxite Mine
Village – Umbershet, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : **10/04/2024**
Sampling Location : Umbershet Village
Sample Collected by : Mr. Navneet
Sampling Protocol : GEL/LAB/SOP/AIR/01
Sampling Duration : **24 Hours**

Sample Description: Ambient Air

RESULTS
(Ambient Air Quality Analysis)

Date	$PM_{2.5}$,µg/m3	PM_{10},µg/m3	SO_2 µg/m3,	NO_2,µg/m3
	GEL/LAB/SOP/AIR /01	IS:5182:Pt-23	IS:5182:Pt-2	IS:5182:Pt-6
03.03.2024	37.0	81.7	6.4	13.1
06.03.2024	37.1	79.1	6.5	12.5
10.03.2024	35.4	80.2	7.5	13.0
12.03.2024	38.5	80.5	8.4	14.3
17.03.2024	36.3	78.3	6.4	13.6
22.03.2024	38.0	80.5	5.0	15.0
24.03.2024	36.3	77.0	6.1	10.2
27.03.2024	38.5	81.1	7.0	12.0
NAAQ Standards, EPA,1986	**60**	**100**	**80**	**80**

End of Report

GAHELI ENVIRONMENTAL LABORATORY PORBANDAR

Authorized Signatory
Varsha Pandey
(Managing Director)

Annexure

Communication of directions/Order passed by Hon'ble National Green Tribunal, WZB, Pune in OA NO. 165/2024 WZ titled as Bhavesh Arun Karekar & Ors. VS. MoEF & CC & ORS vide Order dated 07.08.2024.

SRO Chiplun <srochiplun@mpcb.gov.in>
Mon 19/08/2024 16:30
To:Smita Madhav Khatavkar <lo1@mpcb.gov.in>;Dr. V. M. Motghare <jdair@mpcb.gov.in>
Cc:RO Kolhapur <rokolhapur@mpcb.gov.in>

4 attachments (5 MB)
PD Umbershet Ashapura 25.04.2024.pdf; SCN Ashapura 02.01.2024.pdf; Umbershet PD reply 30.04.2024.pdf; PD Umbershet Ashapura 25.04.2024.pdf;

Madam/Sir,

This office has issued Warning Notice on 21.11.2023, SCN on 02.01.2024 & Proposed Direction on 25.04.2024 Copy enclosed. Industry has not submitted the reply of SCN & reply to PD is submitted. All copies enclosed.
The Mining activities is not in operation due to rainy season.
Submitted for your information plz.

With Regards,
Sanjay Jirapure
Sub Regional Officer,
Maharashtra Pollution Control Board, Chiplun
Email:- srochiplun@mpcb.gov.in,

"SAVE PAPER"-THINK BEFORE YOU PRINT!
POWER BEHIND ENVIRONMENT...M.P.C.B.
सर्व व्यवहारामध्ये मराठीचा वापर करा ! !

From: Smita Madhav Khatavkar <lo1@mpcb.gov.in>
Sent: 19 August 2024 13:57
To: RO Kolhapur <rokolhapur@mpcb.gov.in>; SRO Chiplun <srochiplun@mpcb.gov.in>
Subject: Fw: Fw: Communication of directions/Order passed by Hon'ble National Green Tribunal, WZB, Pune in OA NO. 165/2024 WZ titled as Bhavesh Arun Karekar & Ors. VS. MoEF & CC & ORS vide Order dated 07.08.2024.

Reminder No I
Pl refer email dated 14.08.2024.

Thanks & Regards,
(Smita Madhav Khatavkar)
Law Officer,
Maharashtra Pollution Control Board, Mumbai

"SAVE PAPER"-THINK BEFORE YOU PRINT!
POWER BEHIND ENVIRONMENT...M.P.C.B."

TRUE COPY
ADVOCATE

ANNEXURE-R-5

Directorate of Geology & Mining Government of Maharashtra	**Transit Pass** **Issue Print – 1** **31/03/2024 07:53 AM**	**Transit Pass Number : TDR_00080100000739** **Sr. No.: 000602**	
	Copy For: TSB User **Region:** Kolhapur **District:** Ratnagiri	**Bulk Demand No :** TDR_0008010003 **Vehicle Type:** Tipper **Vehicle No.:** MH08AP4666 **Issued & Printed By:**	
TSB Use Code/Name	Ashapura Minechem Limited		
Tahshil/Village/Sy No.	Dapoli / Umbershet /		
User Validity/IBM Mine Code	12/05/2023 - 11/05/2026 / IMB/5370/2011 / Dealer Reg. No. 2872		
Transit Pass Purpose	In State Store for Onward Transport		
Issue Date	31/03/2024	**Reissue Date**	
Mineral Name	Bauxite	**Grade**	Cement
Net Weight	10.12 MT	**Vehicle No :**	MH08AP4666
Buyer Name / Address	Gamma Iron India Limited / Gat No 43/20 At Nayane Tal Mandangad Dist Ratnagiri		
Route	Umbershet Jetty CBJ - Madivali-Devhare Phata - Nayane Plot		**Distance :**22.00
Mode of Transportation	By Road	**Transporter Name**	A.W.M. Transport
Journey Start Date	31/03/2024 07:53 AM		
Weigh Bridge Name	Ashapura Minechem Ltd	**Driver Name / Licence No**	Salman Mukadam / MH0820230004471

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ANNEXURE-R-6

ST - 1

ST - 2

RW - 1

RW - 2

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ANNEXURE-R-7

Maharashtra: NGT Accuses Ashapura Meinchem Limited Of Violating Environmental Clearance Conditions In Dapoli Bauxite Mining Operations

The National Green Tribunal (NGT) has pulled up Mumbai-based Ashapura Meinchem Limited, which has been conducting bauxite mining operations in UmberShet, Dapoli, Ratnagiri district.

Pranali Lotlikar | **Updated:** Tuesday, August 20, 2024, 04:53 AM IST

National Green Tribunal | FPJ

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Mumbai: The National Green Tribunal (NGT) has pulled up Mumbai-based Ashapura Meinchem Limited, which has been conducting bauxite mining operations in UmberShet, Dapoli, Ratnagiri district. The tribunal noted alleged severe violations of the specific conditions outlined in the Environmental Clearance granted to the company by the Ministry of Environment and Forests (MoEF).

Ashapura Meinchem, a flagship company of the Ashapura Group, is recognized as India's largest mine owner and exporter of bentonite. The company has been engaged in bauxite mining in Dapoli since February 24, 2016. The NGT, in its orders, has directed the Registry to obtain a report from the Maharashtra Pollution Control Board (MPCB) concerning the alleged violations of the terms and conditions by the mining company.

The case against Ashapura Meinchem Limited was initiated by Bhavesh Karekar, who filed a complaint in March against the company and several government environmental concerning agencies. The complaint alleges that the company's activities, including mining, storage, and transportation of products, have severely impacted the residents of nearby villages.

The poor air quality resulting from these activities has reportedly caused significant problems for the local population. Additionally, the company's operations have adversely affected the soil and crops, posing serious risks to human life due to the alleged unsafe transportation practices, including overloading of trucks and poor vehicle maintenance, leading to numerous accidents.

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According to Karekar's application, the company's activities have had several detrimental effects. "Dust particles from the operations are reportedly settling on the leaves of crops, obstructing photosynthesis, and reducing both the yield and quality of the produce. The water scarcity exacerbated by the lack of rainwater harvesting measures further impacts the life cycle of trees and plants, diminishing the area's green cover. The company has also failed to carry out sufficient afforestation along the roads. Moreover, the quality of the soil has deteriorated due to reduced groundwater seepage, a consequence of erosion and surface runoff," reads the application.

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The application also alleged that the company has failed to provide the villagers with any rainwater harvesting mechanisms, which contravenes the consent conditions.

The application further notes that in September 2023, the MPCB had granted the company consent to operate, with a condition that it regularly conducts environmental monitoring in the core zone and quarterly monitoring in the buffer zone, as it is classified as a 'Red Category' industry. However, the company has allegedly completely violated the specific conditions of the environmental clearance.

Read Also

National Green Tribunal Guidelines To Be Followed For Idol Making

After reviewing the evidence, the tribunal held, "In the present application, we may also make it clear that conditions enumerated in the original application are said to have been violated by the company. Therefore, it is incumbent upon the complainants to enumerate the violations of the terms and conditions of the Environmental Clearance (EC)."

The matter is scheduled for a hearing on August 24, where the tribunal will listen to the company's response.

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10:26 Vo)) LTE 0.1 KB/s 97%

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ANNEXURE-R-8

नमस्कार

आपल्या सहकार्यातून मी जी रोवले माईनिंग विरोधात केस दाखल केलेली त्याला पाहिले यश आलेले आहे.

रोवले मध्ये आशापुरा कंपनी ला पहिल्या पडताळणीत १,७४,६०,०००/- आणि २६,७३,६००/- असे दोन दंड बसवले आहेत.

आपली मागणी ही माईनिंग बंद करण्यासाठी आहे आणि लवकरच ती होणार.

आपला विश्वासू
भावेश कारेकर

06:27

https://www.freepressjournal.in/amp/mumbai/maharashtra-ngt-accuses-ashapura-meinchem-limited-of-violating-environmental-clearance-conditions-in-dapoli-bauxite-mining-operations

उंबरशेत केस पण कोर्टात दाखल झाली आहे आणि लवकरच आपल्या बाजूने निर्णय लागेल.

ही बातमी त्याच संदर्भात आहे.

06:27

This message was deleted 08:27

+91 98190 40456
नमस्कार

आपल्या सहकार्यातून मी जी रोवले माईनिंग विरोधात केस दाखल के...

आपल्या गावातून सहकार्य मिळाले असते तर हे २ करोड तुमच्या गावाला मिळावे असा प्रयत्न केला असता.

नुकसान २ करोड पेक्षा जास्त आहे. अजूनही बोलून घ्या आपण. आपण तुमच्या गावाला हे मिळावेत म्हणून प्रयत्न करूयात

08:28

I Undertake to file English Translation at the time of hearing of the Original Application

Message

10:26

<@ +91 98190 40456:

Namaskar

The Case, which, I have filed with your cooperation against Rowale Mining, has got first succeed.

In Rowale, fine of 1,74,60,000/- and 26,73,600/- has been imposed on Ashapura Company in the first verification.

Our demand is to stop mining and it will happen soon.

Your faithfully

Bhavesh Karekar

6:27

https://www.freepressjournal.in/amp/mumbai
/maharashtra-ngt-accuses-ashapura-meinchem
-limited-of-violating-environmental-clearance
-conditions-in-dapoli-bauxite-mining-operations

The Umbershet case has also been filed in the Court and the decision will be in our favor soon.
This news is related to the same.

06:27

This message was deleted

08:27

<@ +91 98190 40456:
Namaskar
The Case, which, I have filed with your cooperation against Rowley Mining

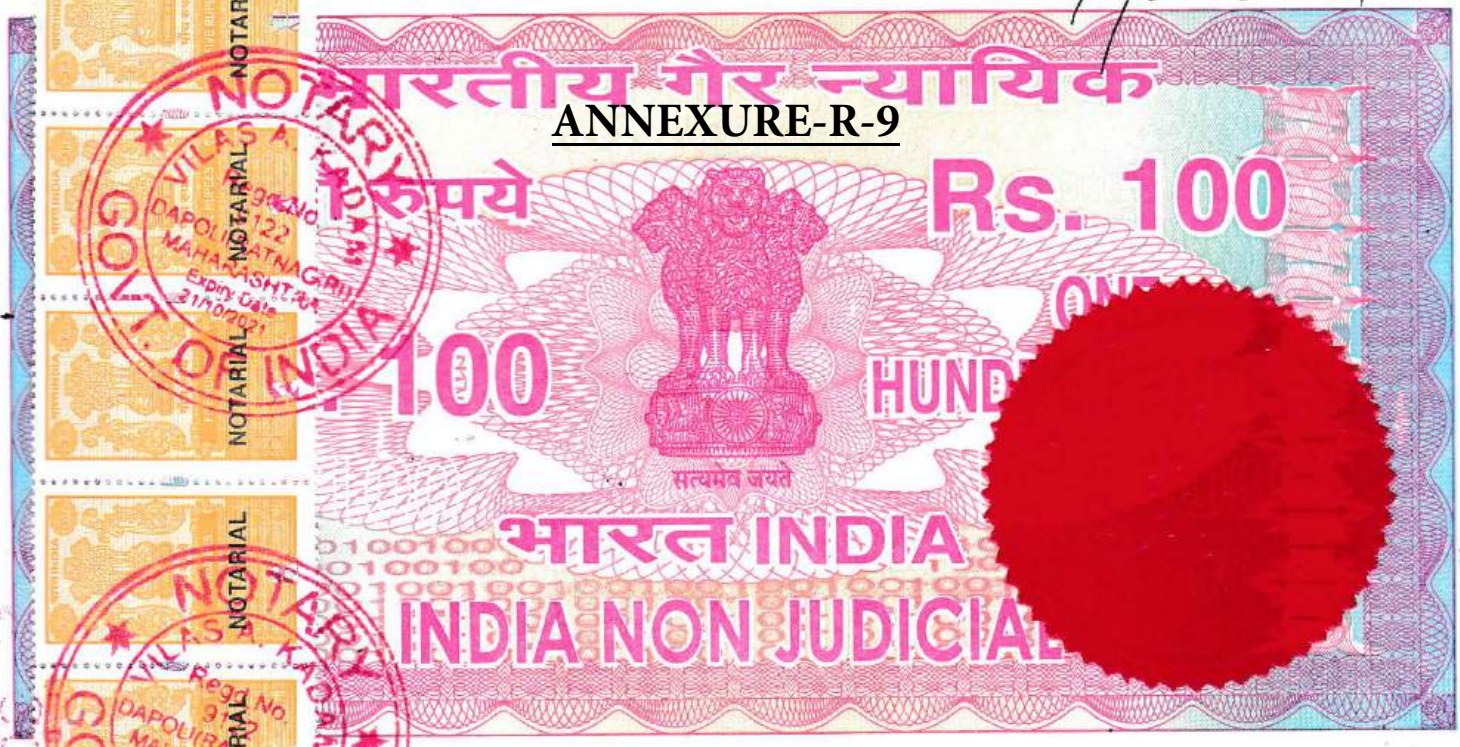
If we had received support from your village, we would have tried to get these 2 Crores for your village.

The loss is more than 2 crores. You can still talk.
Let us, try to get this for your village, so let us try.

8:28

667/2021

ANNEXURE-R-9



ASHTRA ◑ 2020 ◑ - 3 AUG 2021 XM 970187

फक्त - करारपत्र 010719

१ मुद्रांक विक्री नोंदवही अनु . क्रमांक/दिनांक अनु क्रमांक दिनांक 17 AUG

२ मुद्रांक विकत घेणाराचे नाव , रहिवासाचा पत्ता व सही
ASHAPURA MINECHEM LTD.

३ परवानाधारक मुद्रांक विक्रेत्याची सही व परवाना क्रमांक तसेच मुद्रांक विक्रीचे ठिकाण / पत्ता
परवाना क्र ४/९१ ठिकाण घर नं. २१/३(२) पोष्टगल्ली दापोली ता दापोली जि. रत्नागिरी

ज्या कारणासाठी ज्यांनी मुद्रांक खरेदी केला त्यांनी त्याच कारणासाठी मुद्रांक खरेदी केल्यापासुन ६ महिन्यात वापरणे बंधनकारक आहे

SUB TREASURY OFFICE DAPOLI

उप कोषागार अधिकारी दापोली

भाडेकरारपत्र

श्री. संग्राम विश्वास पाटील,
व्यवस्थापक
मे. आशापुरा माईन केम लि.
दापोली करिता. } लिहून घेणार

श्री. संदिप दत्ताराम चिखले,
रा. रोवले, ता.दापोली,
जि. रत्नागिरी } लिहून देणार

महाराष्ट्र MAHARASHTRA ◑ 2020 ◑ - 3 AUG 2021 XM 970188

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सेच मुद्रांक विक्रीचे ठिकाण / पत्ता

परवाना क्र ४/९१ ठिकाण घर नं. २१/३(२)
पोष्टगल्ली दापोली ता दापोली
जि. रत्नागिरी

रणासाठी ज्यांनी मुद्रांक खरेदी केला त्यांनी त्याच कारणासाठी मुद्रांक खरेदी केल्यापासुन ६ महिन्यात वापरणे बंधनकारक आहे

मी श्री. संदिप दत्ताराम चिखले, रा. रोवले, ता. दापोली, जि. रत्नागिरी कारणे भाडेकरारपत्र लिहून देते की, मौजे रोवले, ता. दापोली, जि. रत्नागिरी या स्थळसिमेतील सर्वे नं. ३०/१, ३०/४, २९/४ व २९/११, असे सर्व एकूण क्षेत्र ४-४१-० या जमिनी स्वमालकीच्या व वहिवाटीच्या आहेत.

गावाचे नाव	सर्वे नं.	क्षेत्र
रोवले	३०/१	०-७३-०
	३०/४	१-६२-०
	२९/४	०-५७-०
	२९/११	१-४९-०
	एकूण क्षेत्र	४-४१-०

वर निर्दीष्ट रोवले सर्व्हे नं. बॉक्साईट खनिजयुक्त क्षेत्र महाराष्ट्र शासनातर्फे अधिसूचित केलेल्या लिजक्षेत्रात येत आहेत, याची मला माहिती देण्यात आली. सदर क्षेत्र रापड, पड आहे. सदर वर नमूद क्षेत्र आशापुरा माईन केम लि. दापोली यांना त्यांचे मागणी प्रमाणे बॉक्साईट उत्खननासाठी ०१/०७/२०२१ ते ३० जून २०२५ या कालावधीसाठी भाडेकरारपत्र करून देत आहे.

(१) सर्व्हे नं. २९/११ व ३०/४ चे ०१/०४/२०१७ ते ३१/१२/२०१८ या कालावधीचे प्रतिवर्षी प्रतिहेक्टरी रू. ७,५००/- या प्रमाणे भाडे रू. ४०,८१८.७५/- व ०१/०१/२०१९ ते ३०/०६/२०२१ प्रतिवर्षी प्रतिहेक्टरी रू. १०,०००/- या दराने भाडे रू. ७७,७५०/- असे जमिनीचे एकूण भाडे रू. १,१८,५६८.७५/- (एक लाख अठरा हजार पाचशे अडसष्ट मात्र) भाडे देय ठरत आहे.

(२) सर्व्हे नं. २९/४ चे ०१/०३/२०११ ते २८/०२/२०१६ या कालावधीचे प्रतिवर्षी प्रतिहेक्टरी रू. ५,०००/- या प्रमाणे भाडे रू. १४,२५०/-, ०१/०३/२०१६ ते ३१/१२/२०१८ प्रतिवर्षी प्रतिहेक्टरी रू. ७,५००/- या दराने भाडे रू. १२,११२.५०/- व ०१/०१/२०१९ ते ३०/०६/२०२१ प्रतिवर्षी प्रतिहेक्टरी रू. १०,०००/- या दराने भाडे रू. १४,२५०/- असे जमिनीचे एकूण भाडे रू. ४०,६१२.५०/- (चाळीस हजार सहाशे बारा मात्र) भाडे देय ठरत आहे.

(३) सर्व्हे नं. ३०/१ चे ०१/०१/२०११ ते ३१/१२/२०१५ या कालावधीचे प्रतिवर्षी प्रतिहेक्टरी रू. ५,०००/- या प्रमाणे भाडे रू. १८,२५०/-, ०१/०१/२०१६ ते ३१/१२/२०१७ प्रतिवर्षी प्रतिहेक्टरी रू. ७,५००/- या दराने भाडे रू. १०,९५०/- व ०१/०१/२०१८ ते ३०/०६/२०२१ प्रतिवर्षी प्रतिहेक्टरी रू. १०,०००/- या दराने भाडे रू. २५,५५०/- असे जमिनीचे एकूण भाडे रू. ५४,७५०/- (चौपन्न हजार सातशे पन्नास मात्र) भाडे देय ठरत आहे.

वर निर्दीष्ट जमिनींचे मागिल कालावधीचे एकूण भाडे वरील तपशिलाप्रमाणे रू. २,१३,९३१.२५/- (दोन लाख तेरा हजार नऊशे एकतीस मात्र) होत आहे. ते मला भाडेकरारपत्र मुदतवाढ करताना चेकने देणेचे आहेत.

सदर क्षेत्र रापड, पड असल्याने राष्ट्रीय खनिजयुक्त क्षेत्र अधिसूचनेनुसार बॉक्साईट उत्खननासाठी मे. आशापुरा माईन केम लि. कंपनीला ०१ जुलै २०२१ पासून ३० जून २०२५ या कालावधीकरिता भाडेकरारने प्रतिवर्षी प्रतिहेक्टरी रू. १०,०००/- (दहा हजार मात्र) या प्रमाणे हे भाडेकरारपत्र खालील अटी व शर्तींवर नोटरी समोर स्वाक्षरी करून देत आहे.

भाडेकरारपत्रपत्र लिहून घेणार व लिहून देणार यांच्यात खालील शर्ती बंधनकारक आहेत.

१)भाडेकरार ०१/०७/२०२१ ते ३० जून २०२५ या कालावधीसाठी अमंलात असून सदर भाडेकराराने प्राप्त जमिन बॉक्साईट उत्खननासाठी स्वखुशीने व स्वतःच्या अक्कलहुशारीने दिलेली आहे. सदर भाडेकरारपत्र कालावधीत सदर जागेची विक्री करणार नाही.

२) सदर मिळकतीचा वापर, उत्खनन मे. आशापुरा माईन केम लि. कंपनीने अगर त्यांनी अधिकृत केलेले ठेकेदार यांनी करावयाचे आहे. उत्खननानंतर वा करार संपुष्टात येताच जमिनी खड्डे, भरून पुर्ववत लेव्हल करून तसेच काजू व इतर फळझाडे लागवड करून मला ताब्यात देणेची आहे.

३) लिहून देणार तर्फे अगर मुळकब्जेदार विरूद्ध त्यांचे भाऊबंद, वालीवारस, नातेवाईक वगैरेची कोणतीही हरकत वा तक्रार भाडेकरार कालावधीत उद्भवल्यास त्याचे निवारण करण्याची जबाबदारी खर्चासह लिहून देणार यांची राहील.

४)सदर भाडेकरार कालावधीत सदर मिळकतीचा दस्त, कर इत्यादी लिहून घेणार यांनी परस्पर सरकार जमा करावयाचा आहे.

५)भाडेकरारपत्र विषयी ठरावप्रमाणे काही तक्रारी उद्भवल्यास तंटा निवारण न्यायालयात जावून तडजोड करून घेण्याचा अधिकार दोन्ही पार्टीना हक्क राहील.

६)भाडेकरारपत्राप्रमाणे ०१/०७/२०२१ ते ३० जुन २०२५ या कालावधीत मिळकतीचा ताबा लिहून घेणार यांचेकडे राहील. हे भाडेकरारपत्र वरील मुदतीत वा मुदतीपर्यंत दोन्ही पार्टीस बंधनकारक राहील.

हे भाडेकरारपत्र मी स्वखुशीने व स्वतःच्या अक्कलहुशारीने तसेच कोणाचे व कसलेही दडपण न येता, न आणता लिहून दिले.

लिहून घेणार

श्री. संग्राम विश्वास पाटील,
व्यवस्थापक
मे. आशापुरा माईन केम लि.
दापोली करिता.
Adhar 2470 1514 1166.

लिहून देणार

श्री. संदिप दत्ताराम चिखले

Adhar 9620 0775 7389

साक्षिदार

सही ----------
नाव प्रविण म्हस्कर
पत्ता मौजे दापोली.

Solemnly affirmed
BEFORE ME
VILAS ANANTRAO KADAM
M.Sc.(Agri) LL.B.
Advocate High Court and
Notary Public Govt. of India
Regd. No. 9122
269, Camp Dapoli, Tal. Dapoli,
Dist. Ratnagiri, Maharashtra State
17/08/2021

सही / अगठा करणारे सर्वपक्षकार माझे ओळखीचे आहेत.

This document content Sixteen pages

The Signetures are attested
No Responsibility is accepted
by Notary for the contents
of this documment.

Noted & Registered at
Sr. No. 667 Date. 17/08/2021

Signatories identified by
Shri/ Mrs. Pravin S. Mhaskar
to whom I know personally
Adhar 5400 6535 3500

महाराष्ट्र शासन

गाव नमुना सात (अधिकार अभिलेख पत्रक)

[महाराष्ट्र जमीन महसुल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम ३,५,६ आणि ७]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

ब व उपविभाग ३०/१

भोगवटादार वर्ग -१ शेताचे स्थानीक नाव :

आकारणी	खाते क्र.	भोगवटादाराचे नाव	क्षेत्र	आकार	पो.ख.	फेरफार क्र
आर.चौ.मी	२७२	दिपक मनोहरराव शेंडे				(१४९३)
		विद्यमान व्यवस्थापक आशापुरा माईन केम				(१४९३)
		——सामाईक क्षेत्र——	०.०१००	०.०२		
	१०१०२	संदिप दत्ताराम चिखले	०.३२.००	०.१२	०.४१००	(१४९३)

कुळ, खंड व इतर अधिकार

कुळाचे नाव व खंड

इतर अधिकार

तुकडा

इतर

(१५२९) औदयोगीक वि.से.प्रयोजनासाठी परवानगी घेणेच्या अटीवर ६४४) (१४९३)

इतर

बॉक साईट खनिजयुक्त क्षेत्र म.शा.अधिसूचना MMN-१००३/C.R.५५५/IND-९ Date:०३/०२/२००५ अन्वये १५फेब्रु.२००५ पासून २० वर्षाकरिता मा.जिल्हा.रत्ना.कडील क्र.खनिकर्म१/रोवले/उंबरशेत/सातबारा नोंद/०७/१४ दि.३०/१०/२०१४ . (१६००)

इतर

खरेदी केलेल्या ०.०१.० हे. आर या क्षेत्राामधुन स.नं ३०/५ या मिळकतीमध्ये जाणेयेणेसाठी १० मीटर रुंदीचा रस्ता आहे. (१६८१)

प्रलंबित फेरफार : नाही.

शेवटचा फेरफार क्रमांक : १६८१ व दिनांक : ०७/०१/२०१९

(३४४) (१३२२) (१४९३) (१५२९) (१६४२) (१६६८)

सीमा आणि भुमापन चिन्हे

NOTARY VIJAY KADAM Regd. No. 3122 RATNAGIRI MAHARASHTRA Validity Date 21/10/2021 GOVT OF INDIA

महाभूमि

जिल्हा :- रत्नागिरी

लब्ध न	जल सिंचनाचे साधन	
क्षेत्र		
(१४)	(१५)	
आर.चौ.मी		
.३३००		
.३३००		
.३३००		

महाराष्ट्र शासन

गाव नमुना सात (अधिकार अभिलेख पत्रक)

[महाराष्ट्र जमीन महसुल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम ३,५,६ आणि ७]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

ह द उपविभाग ३०/४

भोगवटादार वर्ग -१

शेताचे स्थानीक नाव :

आकारणी	खाते क्र.	भोगवटादाराचे नाव	क्षेत्र	आकार	पो.ख.	फेरफार क्र	कुळ, खंड व इतर अधिकार
आर.चौ.मी	२७२	दिपक मनोहरराव शेंडे विद्यमान व्यवस्थापक आशापुरा माईन केम ——सामाईक क्षेत्र——	०.१९००	०.०८		(१५२९) (१५२९)	कुळाचे नाव व खंड इतर अधिकार तुकडा
	१०१०२	संदिप दत्ताराम चिखले	०.६१.००	०.२६	१.०१००	(१४६४)	इतर औद्योगिक अकृषिक प्रयोजनासाठी परवानगी घेणेच या अटीवर (१५२९) (३४४) (५९०) इतर बॉक्साईट खनिजयुक्त क्षेत्र म.शा.अधिसूचना MMN-१००३/C.R.५५५/IND-९ Date:०३/०२/२००५अन्वये१५फेब्रु.२००५ पासून २० वर्षाकरिता मा.जिल्हा.रत्ना.कडील क्र. खनिकर्म१/रोवले/उंबरशेत/सातबारा नोंद/०७/१४ दि.३०/१०/१४. (१६००) इतर खरेदी केलेल्या ०.१९.० हे. आर या क्षेत्रामधुन स.नं ३०/५ या मिळकतीमध्ये जाणेयेणेसाठी १० मीटर रुंदीचा रस्ता आहे. (१६८१)

(३४४) (५९०) (१३०८) (१४२४) (१४६४) (१५२९) (१६४५) (१६६७)

प्रलंबित फेरफार : नाही.

शेवटचा फेरफार क्रमांक : १६८१ व दिनांक : ०७/०१/२०१९

सीमा आणि भुमापन चिन्हे

NOTARY VILAS KADAM DAPOLI MAH INDIA GOVT.

महाभूमि

हा ७/१२ अभिलेख (दि.२९/०२/२०२०:१०:०९:२१ AM रोजी) डिजिटल स्वाक्षरीत केला असल्यामुळे त्यावर कोणत्याही सही-शिक्क्याची आवश्यकता नाही.

सूचना : सदर ७/१२ डिजिटल स्वाक्षरीत झाल्यानंतर गा.न.नं. १२ मध्ये फिर्कांची माहिती अद्यावत झाली असल्याने सद्यस्थिती https://bhulekh.mahabhumi.gov.in या संकेत स्थळावर पहावी. ७/१२ डाउनलोड व वैध दि. : १७/०८/२०२१ : ११:१०:०३ AM. वैधता पडताळणीसाठी https://digitalsatbara.mahabhumi.gov.in/dslr/ या संकेत स्थळावर जाऊन 32021000012070B9 हा क्रमांक वापरावा.

महाराष्ट्र शासन

गाव नमुना सात (अधिकार अभिलेख पत्रक)

[महाराष्ट्र जमीन महसुल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम ३,५,६ आणि ७]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

उपविभाग २९/४

भोगवटादार वर्ग -१ शेताचे स्थानीक नाव :

आकारणी	खाते क्र.	भोगवटादाराचे नाव	क्षेत्र	आकार	पो.ख.	फेरफार क्र	कुळ, खंड व इतर अधिकार
आर.चौ.मी	१०११४	संदीप दत्ताराम चिखले	०.५०.००	०.२१	०.०७००	(३४४)	कुळाचे नाव व खंड
							इतर अधिकार
							तुकडा
							इतर
							वॉक साईट खनिजयुक्त क्षेत्र म.शा.अधिसूचना MMN-१००३/C.R.५५५/IND-९ Date:०३/०२/२००५अन्वये१५फेब्रु.२००५ पासून २० वर्षाकरिता मा.जिल्हा.रत्ना.कडील क्र. खनिकर्म१/रोवले/उंबरशेत/सातबारा नोंद/०७/१४ दि.३०/१०/१४. (१६००)
							प्रलंबित फेरफार : नाही.
							शेवटचा फेरफार क्रमांक : १६६७ व दिनांक : १५/०५/२०१८
							सीमा आणि भुमापन चिन्हे

(३४४) (१३२२) (१४९३) (१६४४) (१६६७)

NOTARY ... KADAM ... GOVT. ... INDIA

महाभूमि

हा ७/१२ अभिलेख (दि.०५/१०/२०१९:१२:३५:१२ PM रोजी) डिजिटल स्वाक्षरीत केला असल्यामुळे त्यावर कोणत्याही सही-शिक्क्याची आवश्यकता नाही.

पृष्ठ क्र. १/२

सुचना : सदर ७/१२ डिजिटल स्वाक्षरीत झाल्यानंतर गा.न.नं. १२ मध्ये पिकांची माहिती अद्यावत झाली असल्याने सद्यस्थिती https://bhulekh.mahabhumi.gov.in या संकेत स्थळावर पहावी.

७/१२ डाउनलोड व वैध दि. : १७/०८/२०२१ : ११:१०:३९ AM. वैधता पडताळणीसाठी https://digitalsatbara.mahabhumi.gov.in/dslr/ या संकेत स्थळावर जाऊन 3202100001023609 हा क्रमांक वापरावा.

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जिल्हा :- रत्नागिरी

उपलब्ध सीन	जल सिंचनाचे साधन
क्षेत्र	
(१४)	(१५)
हे.आर.चौ.मी	
०.२०००	
०.२०००	
०.२०००	

महाराष्ट्र शासन

गाव नमुना सात (अधिकार अभिलेख पत्रक)

[महाराष्ट्र जमीन महसुल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम ३,५,६ आणि ७]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

भूमापन उपविभाग २९/११

भोगवटादार वर्ग -१ शेताचे स्थानीक नाव :

आकारणी	खाते क्र.	भोगवटादाराचे नाव	क्षेत्र	आकार	पो.ख.	फेरफार क्र	कुळ, खंड व इतर अधिकार
हे.आर.चौ.मी	१०१०२	संदिप दत्ताराम चिखले	१.१६.००	०.३७	०.३३००	(१४६४)	कुळाचे नाव व खंड
एन.ए.क्षेत्र							इतर अधिकार
							तुकडा
१६.००							इतर
							बोजा - राष्ट्रीयकृत बँक गहाण
१६.००							बँक ऑफ इंडिया शाखा केळशी ३,००,००० मात्रचा बोजा ठेवणे (१५२२)
							इतर
							बॉक साईट खनिजयुक्त क्षेत्र म.शा.अधिसूचना MMN-१००३/C.R.५५५/IND-९ Date:०३/०२/२००५अन्वये१५फेब्रु.२००५ पासून २० वर्षाकरिता मा.जिल्हा.रत्ना.कडील क्र. खनिकर्म१/रोवले/उंबरशेत/सातबारा नोंद/०७/१४ दि.३०/१०/१४. (१६००)
							प्रलंबित फेरफार : नाही.
							शेवटचा फेरफार क्रमांक : १६६८ व दिनांक : १६/०५/२०१८

(५४४) (५९०) (८३६) (१३०८) (१४२४) (१४६४) (१६४८) (१६६८)

सीमा आणि भुमापन चिन्हे

ई महाभूमि

VILLAGE NOTARY DAPOLI MAHARASHTRA Expiry 21/10/20 GOVT. OF INDIA

ही ७/१२ अभिलेख (दि.०५/१०/२०१९:०१:०१:०९ PM रोजी) डिजिटल स्वाक्षरीत केला असल्यामुळे त्यावर कोणत्याही सही-शिक्क्याची आवश्यकता नाही.

सुचना : सदर ७/१२ डिजिटल स्वाक्षरीत झाल्यानंतर गा.न.नं. १२ मध्ये पिकांची माहिती अद्यावत झाली असल्याने सद्यस्थिती https://bhulekh.mahabhumi.gov.in या संकेत स्थळावर पहावी. ७/१२ डाउनलोड व वैध दि. : १७/०८/२०२१ : ११:१५:०८ AM. वैधता पडताळणीसाठी https://digitalsatbara.mahabhumi.gov.in/dslr/ या संकेत स्थळावर जाऊन 320210000102370 2 हा क्रमांक वापरावा.

पृष्ठ क्र. १/२

mi.gov.in या संकेत स्थळावर पहावी.
वर जाऊन 320210000102360 9 हा

२९]

जिल्हा :- रत्नागिरी

उपलब्ध मीन	जल सिंचनाचे साधन	
क्षेत्र		
(१४)	(१५)	
हे.आर.चौ.मी		
०.३६००		
०.३६००		
०.३६००		

...gov.in या संकेत स्थळावर पहावी.
...वर जाऊन 32021000010237O2 हा

आधार

भारतीय विशिष्ट ओळख प्राधिकरण

भारत सरकार

Unique Identification Authority of India

Government of India

नोंदविण्याचा क्रमांक / Enrollment No 1218/16842/02708

To,
संग्राम विश्वास पाटील
Sangram Vishwas Patil
Shenavi Galli
Sonarwadi
Kolhapur
Maharashtra 416209
9423275950

26/02/2013

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आपला आधार क्रमांक / Your Aadhaar No. :

2470 1514 1166

आधार - सामान्य माणसाचा अधिकार

भारत सरकार

Government of India

संग्राम विश्वास पाटील
Sangram Vishwas Patil
जन्म तारीख / DOB : 04/07/1972
पुरुष / Male

2470 1514 1166

आधार - सामान्य माणसाचा अधिकार

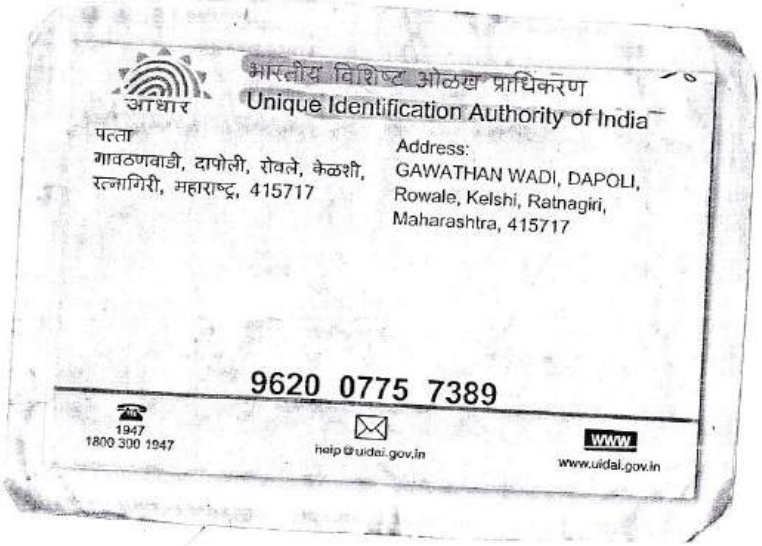
NOTARY
VILAS A. KADAM
Regd No. 22
DAPOLI (DIST. RATNAGIRI)
MAHARASHTRA
Expiry Date
21/10/2021
OF INDIA

भारत सरकार
Government of India

संदिप दत्ताराम चिखले
Sandip Dattaram Chikhale
वडील : दत्ताराम चिखले
Father : DATTARAM CHIKHALE
जन्म तारीख / DOB : 09/10/1980
पुरुष / Male

9620 0775 7389

आधार - सामान्य माणसाचा अधिकार



आधार
भारतीय विशिष्ट ओळख प्राधिकरण
Unique Identification Authority of India

पत्ता
गावठणवाडी, दापोली, रोवले, केळशी, रत्नागिरी, महाराष्ट्र, 415717

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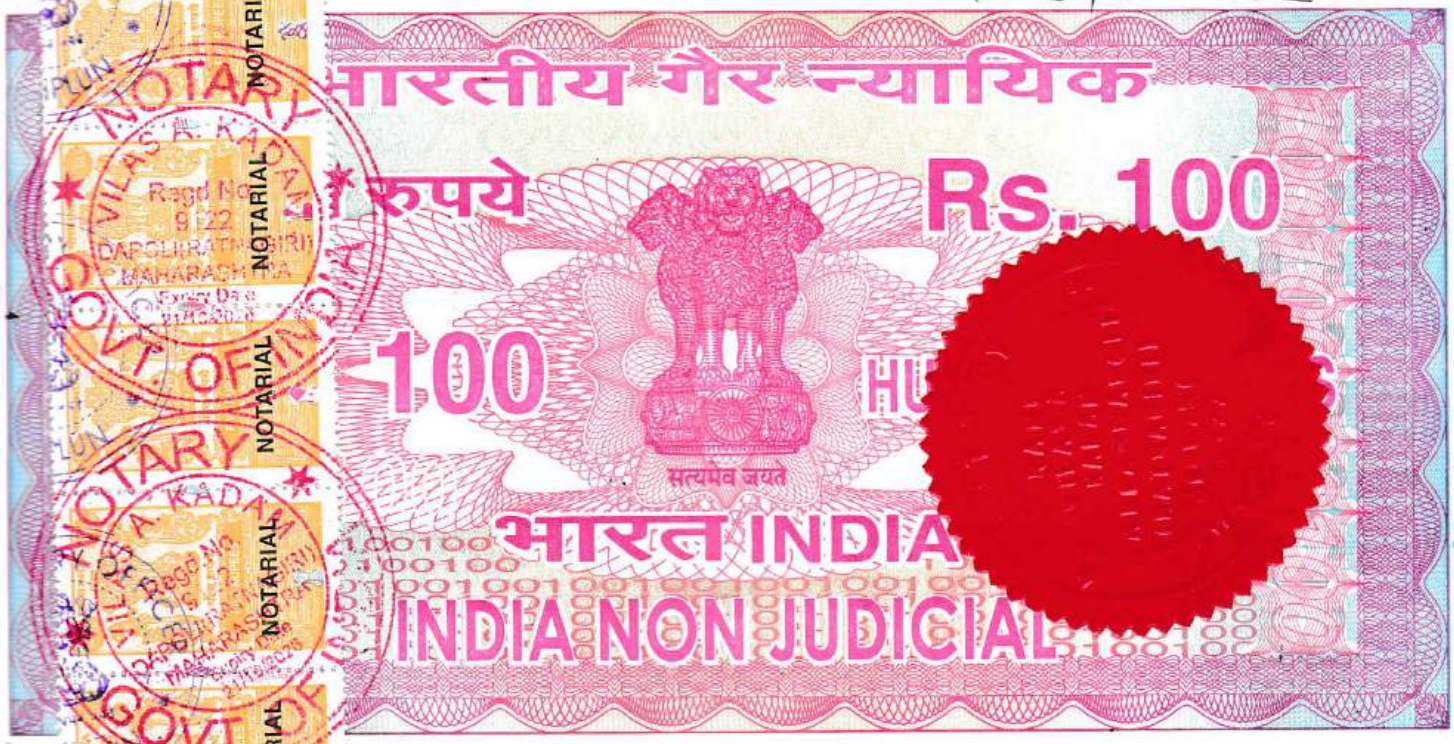

महाराष्ट्र SHTRA ◑ 2020 ◑ 23 MAY 2022 XM 887539

फक्त - करारपत्र

१ मुद्रांक विक्री नोंदवही अनु . क्रमांक/दिनांक — अनु क्रमांक 011995 — दिनांक 16 JUN 2022

२ मुद्रांक विकत घेणाराचे नाव , रहिवासाचा पत्ता व सही — ASHAPURA MINECHEM LTD.

३ परवानाधारक मुद्रांक विक्रेत्याची सही व परवाना क्रमांक तसेच मुद्रांक विक्रीचे ठिकाण / पत्ता — परवाना क्र ४/९१ ठिकाण घर नं. २१/३(२)

ज्या कारणासाठी ज्यांनी मुद्रांक खरेदी केला त्यांनी त्याच कारणासाठी मुद्रांक खरेदी केलेपासुन ६ महिन्यात वापरणे बंधनकारक आहे

भाडेकरारपत्र

श्री. संग्राम विश्वास पाटील,
व्यवस्थापक
मे. आशापुरा माईन केम लि.
दापोली करिता.

लिहून घेणार

श्री. कृष्णा बाबू चव्हाण, उ. व. ६९,
रा. रोवले, (गावठाण वाडी)
ता. दापोली. जि. रत्नागिरी.

लिहून देणार

मी स्वाक्षरी करून भाडेकरारपत्र करून देतो की, मौजे रोवले ता. दापोली, जि. रत्नागिरी येथे खालील नमूद क्षेत्र प्रत्यक्ष माझे ताब्यात व वहीवाटीस असून खुद्द व वारसाने सामाईक मालकीचे आहे.

भारतीय गैर न्यायिक

एक सौ रुपये Rs. 100

रु. 100 ONE HUNDRED RUPEES

सत्यमेव जयते

भारत INDIA

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महाराष्ट्र MAHARASHTRA ◑ 2020 ◑ 23 MAY 2022 XM 887540

SUB TREASURY OFFICE DAPOLI सत्यमेव जयते

VILLAGE DAPOLI MAHARASHTRA GOVT. OF INDIA

पक्षकार - करारपत्र

1 दस्त नोंदवही अनु . क्रमांक/दिनांक — अनु क्रमांक 011995 दिनांक 17 JUN 2022

2 दस्त विक्री घेणाराचे नाव , रहिवासाचा पत्ता व सही — ASHAPURA MINECHEM LTD.

3 मुद्रांक विक्रेत्याची सही व परवाना क्रमांक / दस्त मुद्रांक विक्रीचे ठिकाण / पत्ता — परवाना क्र ४/९१ ठिकाण घर नं. २१/३(२) पोष्टगल्ली दापोली ता दापोली जि. रत्नागिरी

4 दस्तासाठी ज्यांनी मुद्रांक खरेदी केला त्यांनी त्याच कारणासाठी मुद्रांक खरेदी केल्यापासुन ६ महिन्यात वापरणे बंधनकारक आहे

सह दुय्यम निबंधक दापोली

गावाचे नाव	सर्व्हे नं.	क्षेत्र
रोवले	२७/६	०-३०-०
रोवले	२९/१२	०-४३-०
रोवले	२९/८	१-०९-०
		१-८२-०

सदर क्षेत्र पड असल्याने बॉक्साईट या राष्ट्रीय खनिज उत्खननासाठी सर्व्हे नं. २७/६ व २९/१२, मी ०१ ऑक्टोबर २०१० पासून ३० सप्टेंबर २०२१ पर्यंत व सर्व्हे नं. २९/८, मी ०१ एप्रिल २००५ पासून ३१ मार्च २०२२ पर्यंत भाडेकरार केलेला आहे. मी सदर भाडेकराराची मुदत ०१ एप्रिल २०२२ ते ३१ मार्च २०२५ पर्यंत ३ वर्षाच्या कालावधीकरिता वाढवून देत आहे. मी सर्व सहकब्जेदारांची संमत्ती घेऊन हे भाडेकरारपत्र करत आहे. मला मिळणारी भाड्याची रक्कम आम्ही आपापसात समान हिश्श्याने घेणार आहोत. याबद्दल कोणाची कोणतीही हरकत वा तक्रार नाही.

(१) सर्व्हे नं. २७/६ व २९/१२, एकूण क्षेत्र ०-७३-० चे ०१/१०/२०१८ ते ३०/०९/२०१९ या कालावधीचे प्रतिवर्षी प्रतिहेक्टरी रू. ७,५००/- या प्रमाणे भाडे रू. ५,४७५/- व ०१/१०/२०१९ ते ३१/०३/२०२३ प्रतिवर्षी प्रतिहेक्टरी रू. १०,०००/- या दराने भाडे रू. २५,५५०/- असे जमिनीचे एकूण भाडे रू. ३१,०२५/- (एकतीस हजार पंचवीस मात्र) भाडे देय ठरत आहे.

(२) सर्व्हे नं. २९/८, एकूण क्षेत्र १-०९-० चे ०१/०४/२०१८ ते ३१/०३/२०१९ या कालावधीचे प्रतिवर्षी प्रतिहेक्टरी रू. ७,५००/- या प्रमाणे भाडे रू. ८,१७५/- व ०१/०४/२०१९ ते ३१/०३/२०२३ प्रतिवर्षी प्रतिहेक्टरी रू. १०,०००/- या दराने भाडे रू. ४३,६००/- असे जमिनीचे एकूण भाडे रू. ५१,७७५/- (एकावन्न हजार सातशे पंच्याहत्तर मात्र) भाडे देय ठरत आहे.

वर निर्दीष्ट जमिनींचे मागिल कालावधीचे एकूण भाडे वरील तपशिलाप्रमाणे रू. ८२,८००/- (ब्याऐंशी हजार आठशे मात्र) होत आहे. ते मला भाडेकरारपत्र मुदतवाढ करताना चेकने देणेचे आहेत.

भाडेकरारपत्रपत्र लिहून घेणार व लिहून देणार यांच्यात खालील शर्ती बंधनकारक आहेत.

१) भाडेकरार ०१/०४/२०२२ ते ३१/०३/२०२५ या कालावधीसाठी अमंलात असून सदर भाडेकराराने प्राप्त जमिन बॉक्साईट उत्खननासाठी स्वखुशीने व स्वतःच्या अक्कलहुशारीने दिलेली आहे.

२) सदर मिळकतीचा वापर, उत्खनन मे. आशापुरा माईन केम लि. कंपनीने अगर त्यांनी अधिकृत केलेले ठेकेदार यांनी करावयाचे आहे. उत्खननानंतर वा करार संपुष्टात येताच जमिनी खड्डे, भरून पुर्ववत लेव्हल करून तसेच काजू व इतर फळझाडे लागवड करून आम्हांला ताब्यात देणेची आहे.

३) लिहून देणार तर्फे अगर मुळकब्जेदार विरूद्ध त्यांचे भाऊबंद, वालीवारस, नातेवाईक वगैरेंची कोणतीही हरकत वा तक्रार भाडेकरार कालावधीत उद्भवल्यास त्याचे निवारण करण्याची जबाबदारी खर्चासह लिहून देणार यांची राहील.

४)सदर भाडेकरार कालावधीत सदर मिळकतीचा दस्त, कर इत्यादी लिहून घेणार यांनी परस्पर सरकार जमा करावयाचा आहे.

५)भाडेकरारपत्र विषयी ठरावाप्रमाणे काही तक्रारी उद्भवल्यास तंटा निवारण न्यायालयात जावून तडजोड करून घेण्याचा अधिकार दोन्ही पार्टीना हक्क राहील.

कुळ वाल्ल चहुळ'

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Sr. No. 483 Date. 07/06/2022

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by Notary for the contents
of this documment.

६) भाडेकरारपत्राप्रमाणे ०१/०४/२०२२ ते ३१ मार्च २०२५ या कालावधीत मिळकतीचा ताबा लिहून घेणार यांचेकडे राहील. हे भाडेकरारपत्र वरील मुदतीत वा मुदतीपर्यंत दोन्ही पार्टीस बंधनकारक राहील.

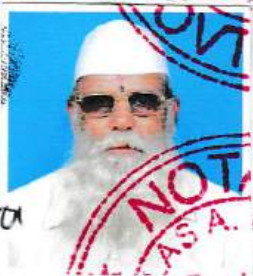
हे भाडेकरारपत्र मी स्वखुशीने व स्वत:च्या अक्कलहुशारीने तसेच कोणाचे व कसलेही दडपण न येता, न आणता लिहून दिले.

लिहून घेणार

श्री. संग्राम विश्वास पाटील,
व्यवस्थापक
मे. आशापुरा माईन केम लि. ASHAPURA MINECHEM LTD.
दापोली करिता.

Adhar No- 2470 1514 1166

लिहून देणार



श्री. कृष्णा बाबू चव्हाण

Adhar NO- 3617 6176 9936

साक्षिदार

सही ----------
नाव प्रविण श्रीकांत म्हसकर
पत्ता ---------- मौजे दापोली

This document content Fourteen pages

BEFORE ME
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M.Sc.(Agri.),LL.B.
Advocate High Court and
Notary Public Govt. of India
Regd. No. 9122
269, Camp Dapoli, Tal. Dapoli,
Dist. Ratnagiri, Maharashtra State
07/06/2022

खिलारे रांका जालांगक
कु.पो. जालांग कुमारवी
ता. दापोली रत्नागिरी

सही / अगठा करणारे सर्वपक्षकार
माझे ओळखीचे आहेत

Signatories identified by,
Shri/ Mrs. प्रविण श्रीकांत म्हसकर.
to whom I know personally
Adhar No- 5400 6535 3500

महाराष्ट्र शासन

गाव नमुना सात (अधिकार अभिलेख पत्रक)

[महाराष्ट्र जमीन महसुल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम ३,५,६ आणि ७]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

भू-क्रमांक व उपविभाग २७/६

धारणा पद्धती भोगवटादार वर्ग-१ शेताचे स्थानीक नाव :

कुळक व आकारणी	खाते क्र.	भोगवटादाराचे नाव	क्षेत्र	आकार	पो.ख.	फेरफार क्र	कुळ, खंड व इतर अधिकार
कुळक हे.आर.चौ.मी.	३८	अनिता अनंत बंगाल				(१५२०)	कुळाचे नाव व खंड
		दत्ताराम बाबू चव्हाण				(१५२०)	
सोप्य क्षेत्र		राजेश शांताराम चव्हाण				(१५२०)	इतर अधिकार
–		कृष्णा बाबू चव्हाण				(१५२०)	तुकडा
–		सुरेश बाबू चव्हाण				(१५२०)	तुकडा
०.२८.००		भालचंद्र बाबू चव्हाण				(१५२०)	तुकडा
		——सामाईक क्षेत्र——	०.२८००	०.१९	०.०२००		इतर
०.२८.००							बॉक्साईट खनिजयुक्त क्षेत्र म.शा.अधिसुचना MMN-१००३/C.R.५५५/IND-९ Date:०३/०२/२००५ अन्वये १५ फेब्रुवारी २००५ पासून २० वर्षांकरिता, मा. जिल्हा. रत्ना. कडील क्र. खानिकाम-१/रोवले/ उंबरशेत/सातबारा नोंद/०७/१४, दिनांक ३०/१०/२०१४. (१६००)
							प्रलंबित फेरफार : नाही.
							शेवटचा फेरफार क्रमांक : १६४० व दिनांक : १९/०४/२०१७
							सीमा आणि भुमापन चिन्हे

ई महाभूमि

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कृष्णा बाबू चव्हाण

फेरफार क्रमांक : (१२१) (३१६) (३४४) (४८९) (८३६) (११५३) (१५२०) (१५२१) (१६४०)

हा ७/१२ अभिलेख (दि.०४/१०/२०१९:०४:०९:५१ PM रोजी) डिजिटल स्वाक्षरीत केला असल्यामुळे त्यावर कोणत्याही सही-शिक्क्याची आवश्यकता नाही.

सूचना: तांत्रिक अडचणी खातर तलाठी यांचे कडील डिजिटल स्वाक्षरी प्रक्रिया प्रलंबित असल्याने हा ७/१२ अभिलेख अद्ययावत नाही. यावर फेरफार नोंद क्र. १६४० मंजूर आहे.तसेच गा. न. नं. १२ मध्ये पिकांची माहिती देखील अद्ययावत झाली आहे तथापि अद्याप याबाबतचा बदल या ७/१२ वर घेण्यात आलेला नाही यांची कृपया नोंद घ्यावी.

७/१२ डाउनलोड दि. : ०७/०६/२०२२ : ११:५८:४४ AM. वैधता पडताळणीसाठी https://digitalsatbara.mahabhumi.gov.in/dslr/ या संकेत स्थळावर जाऊन 3202100001022866 हा क्रमांक वापरावा

गाव नमुना बारा (पिकांची नोंदवही)

[महाराष्ट्र जमीन महसूल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ खालील नियम २९]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

भुमापन क्रमांक व उपविभाग २७/६

			पिकाखालील क्षेत्राचा तपशील									लागवडीसाठी उपलब्ध नसलेली जमीन		जल सिंचनाचे साधन	
			मिश्र पिकाखालील क्षेत्र						निर्भेळ पिकाखालील क्षेत्र						
						घटक पिके व प्रत्येकाखालील क्षेत्र									
वर्ष	हंगाम	खाते क्रमांक				पिकांचे नाव	जल सिंचित	अजल सिंचित	पिकांचे नाव	जल सिंचित	अजल सिंचित	स्वरूप	क्षेत्र		
(१)	(२)	(३)	(४)	(५)	(६)	(७)	(८)	(९)	(१०)	(११)	(१२)	(१३)	(१४)	(१५)	
							हे.आर.चौ.मी	हे.आर.चौ.मी		हे.आर.चौ.मी	हे.आर.चौ.मी		हे.आर.चौ.मी		
२०१७-१८	खरीप											राखड	०.२८००		
२०१८-१९	खरीप											राखड	०.२८००		
२०१९-२०	खरीप											राखड	०.२८००		

टीप : *४ - मिश्रणाचा संकेत क्रमांक, *५ - जल सिंचित, *६ - अजल सिंचित

ई महाभूमि

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हा ७/१२ अभिलेख (दि.०४/१०/२०१९:०४:०९:५१ PM रोजी) डिजिटल स्वाक्षरीत केला असल्यामुळे त्यावर कोणत्याही सही-शिक्क्याची आवश्यकता नाही. पृष्ठ क्र

सूचना: तांत्रिक अडचणी खातर तलाठी यांचे कडील डिजिटल स्वाक्षरी प्रक्रिया प्रलंबित असल्याने हा ७/१२ अभिलेख अद्ययावत नाही. यावर फेरफार नोंद क्र. १६४० मंजूर आहे.तसेच गा. न. नं. १२ मध्ये पिकांची माहिती देखील अद्ययावत झाली आहे तथापि अद्याप याबाबतचा बदल या ७/१२ वर घेण्यात आलेला नाही याची कृपया नोंद घ्यावी.

७/१२ डाउनलोड दि. : ०७/०६/२०२२ : ११:५८:४४ AM. वैधता पडताळणीसाठी https://digitalsatbara.mahabhumi.gov.in/dslr/ या संकेत स्थळावर जाऊन 320210000122866 हा क्रमांक वापरावा

महाराष्ट्र शासन

गाव नमुना सात (अधिकार अभिलेख पत्रक)

[महाराष्ट्र जमीन महसुल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम ३,५,६ आणि ७]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

न क्रमांक व उपविभाग २९/१२

पद्धती भोगवटादार वर्ग -१ शेताचे स्थानीक नाव :

कक व आकारणी	खाते क्र.	भोगवटादाराचे नाव	क्षेत्र	आकार	पो.ख.	फेरफार क्र	कुळ, खंड व इतर अधिकार
कक हे.आर.चौ.मी	३८	अनिता अनंत बंगाल				(१५२१)	कुळाचे नाव व खंड
		दत्ताराम बाबू चव्हाण				(१५२१)	
गवड योग्य क्षेत्र		राजेश शांताराम चव्हाण				(१५२१)	इतर अधिकार
-		कृष्णा बाबू चव्हाण				(१५२१)	तुकडा
-		सुरेश बाबू चव्हाण				(१५२१)	इतर
०.३७.००		भालचंद्र बाबू चव्हाण				(१५२१)	बॉक्साईट खनिजयुक्त क्षेत्र म.शा.अधिसूचना MMM-१००३/C.R.५५५/IND-९ Date:०३/०२/२००५ अन्वये. (१६००) १५फेब्रु.२००५ पासून २० वर्षाकरिता मा.जिल्हा.रत्ना.कडील क्र. (१६००) खनिकर्म१/रोवले/उंबरशेत/सातबारा नोंद/०७/१४ दि.३०/१०/१४ (१६००)
		------सामाईक क्षेत्र------	०.३७००	०.१७	०.०६००		
क्षेत्र ०.३७.००							
बराय क्षेत्र							
वड (अ.योग्य) ०.०६.००							
०.०६.००							
०.१३.००							
०.१७							
वा विशेष							
ी							

प्रलंबित फेरफार : नाही.

शेवटचा फेरफार क्रमांक : १६३० व दिनांक : १४/०२/२०१७

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कृष्णा बाबू चव्हाण

फार क्र : (१) (१२२) (३४४) (११५३) (१५२०) (१५२१) (१६३०)

सीमा आणि भुमापन चिन्हे

गाव नमुना बारा (पिकांची नोंदवही)

[महाराष्ट्र जमीन महसूल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम २९]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

भुमापन क्रमांक व उपविभाग २९/१२

			पिकाखालील क्षेत्राचा तपशील									लागवडीसाठी उपलब्ध नसलेली जमीन		जल सिंचनाचे साधन	
			मिश्र पिकाखालील क्षेत्र						निर्भेळ पिकाखालील क्षेत्र						
						घटक पिके व प्रत्येकाखालील क्षेत्र									
वर्ष	हंगाम	खाते क्रमांक				पिकांचे नाव	जल सिंचित	अजल सिंचित	पिकांचे नाव	जल सिंचित	अजल सिंचित	स्वरूप	क्षेत्र		
(१)	(२)	(३)	(४)	(५)	(६)	(७)	(८)	(९)	(१०)	(११)	(१२)	(१३)	(१४)	(१५)	
							हे.आर.चौ.मी	हे.आर.चौ.मी		हे.आर.चौ.मी	हे.आर.चौ.मी		हे.आर.चौ.मी		
२०१७-१८	खरीप											रापड	०.३७००		
२०१८-१९	खरीप											रापड	०.३७००		
२०१९-२०	खरीप											रापड	०.३७००		

टीप : *४ - मिश्रणाचा संकेत क्रमांक, *५ - जल सिंचित, *६ - अजल सिंचित

ई महाभूमि

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हा ७/१२ अभिलेख (दि.०५/१०/२०१९:०१:०२:४१ PM रोजी) डिजिटल स्वाक्षरीत केला असल्यामुळे त्यावर कोणत्याही सही-शिक्क्याची आवश्यकता नाही. पृष्ठ १

सूचना: तांत्रिक अडचणी खातर तलाठी यांचे कडील डिजिटल स्वाक्षरी प्रक्रिया प्रलंबित असल्याने हा ७/१२ अभिलेख अद्ययावत नाही. यावर फेरफार नोंद क्र. १६३० मंजूर आहे.तसेच गा. न. नं. १२ मध्ये पिकांची माहिती देखील अद्ययावत झाली आहे तथापि अद्याप याबाबतचा बदल या ७/१२ वर घेण्यात आलेला नाही यांची कृपया नोंद घ्यावी.

७/१२ डाउनलोड दि. : ०७/०६/२०२२ : १३:०१:५० PM. वैधता पडताळणीसाठी https://digitalsatbara.mahabhumi.gov.in/dslr/ या संकेत स्थळावर जाऊन 32021000001023710 हा क्रमांक वापरावा

महाराष्ट्र शासन

गाव नमुना सात (अधिकार अभिलेख पत्रक)

[महाराष्ट्र जमीन महसुल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम ३,५,६ आणि ७]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

क्रमांक व उपविभाग २९/८

पद्धती भोगवटादार वर्ग-१ शेताचे स्थानीक नाव :

कक व आकारणी	खाते क्र.	भोगवटादाराचे नाव	क्षेत्र	आकार	पो.ख.	फेरफार क्र	कुळ, खंड व इतर अधिकार
कक हे.आर.चौ.मी	३८	अनिता अनंत बंगाल				(१३२०)	कुळाचे नाव व खंड
		कृष्णा बाबू चव्हाण				(१३२०)	
वड योग्य क्षेत्र		दत्ताराम बाबू चव्हाण				(१३२०)	इतर अधिकार
०.९७.००		भालचंद्र बाबू चव्हाण				(१३२०)	तुकडा
-		सुरेश बाबू चव्हाण				(१३२०)	इतर
		राजेश शांताराम चव्हाण				(१५२०)	इतर
त्र ०.९७.००		------सामाईक क्षेत्र------	०.९७००	०.३३	०.१२००		इतर
							इतर
राब क्षेत्र*							बॉक्साईट खनिजयुक्त क्षेत्र म.शा.अधिसुचना MMN-१००३/C.R.५५५/IND-९ Date:०३/०२/२००५ अन्वये १५ फेब्रुवारी २००५ पासून २० वर्षांकरिता, मा. जिल्हा. रत्ना. कडील क्र. खानिकाम-१/रोवले/ उंबरशेत/सातबारा नोंद/०७/१४, दिनांक ३०/१०/२०१४. (१६००)
वड अयोग्य)							
०.१२.००							
०.१२.००							प्रलंबित फेरफार : नाही.
०.३३							शेवटचा फेरफार क्रमांक : १६४० व दिनांक : १९/०४/२०१७
विशेष							

कृष्णा बाबू चव्हाण

फेरफार क्र : (१२१) (३४४) (५९०) (६०१) (८३६) (११५३) (१२२६) (१३२०) (१५२१) (१६४०)

सीमा आणि भुमापन चिन्हे

ई महाभूमि
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गाव नमुना बारा (पिकांची नोंदवही)

[महाराष्ट्र जमीन महसूल अधिकार अभिलेख आणि नोंदवह्या (तयार करणे व सुस्थितीत ठेवणे) नियम १९७१ यातील नियम २९]

गाव :- रोवले (५६४८०२) तालुका :- दापोली जिल्हा :- रत्नागिरी

भुमापन क्रमांक व उपविभाग २९/८

			पिकाखालील क्षेत्राचा तपशील									लागवडीसाठी उपलब्ध नसलेली जमीन		जल सिंचनाचे साधन	
			मिश्र पिकाखालील क्षेत्र						निर्भेळ पिकाखालील क्षेत्र						
						घटक पिके व प्रत्येकाखालील क्षेत्र									
वर्षे	हंगाम	खाते क्रमांक				पिकांचे नाव	जल सिंचित	अजल सिंचित	पिकांचे नाव	जल सिंचित	अजल सिंचित	स्वरूप	क्षेत्र		
(१)	(२)	(३)	(४)	(५)	(६)	(७)	(८)	(९)	(१०)	(११)	(१२)	(१३)	(१४)	(१५)	
							हे.आर.चौ.मी	हे.आर.चौ.मी		हे.आर.चौ.मी	हे.आर.चौ.मी		हे.आर.चौ.मी		
२०१७-१८	खरीप								नाचणी		०.५०००	रावपड	०.४७००		
२०१८-१९	खरीप								नाचणी		०.५०००	रावपड	०.४७००		
२०१९-२०	खरीप								नाचणी		०.५०००	रावपड	०.४७००		

टीप : *४ - मिश्रणाचा संकेत क्रमांक, *५ - जल सिंचित, *६ - अजल सिंचित

ई महाभूमि

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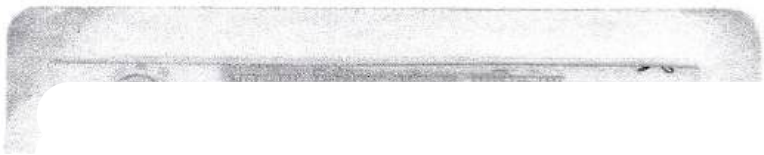
कुळाचा खाचा चढ्ढा।

हा ७/१२ अभिलेख दि.०५/१०/२०१९:१२:५८:२४ PM रोजी डिजिटल स्वाक्षरीत केला असल्यामुळे त्यावर कोणत्याही सही-शिक्क्याची आवश्यकता नाही.

सूचना: तांत्रिक अडचणी खातर तलाठी यांचे कडील डिजिटल स्वाक्षरी प्रक्रिया प्रलंबित असल्याने हा ७/१२ अभिलेख अद्ययावत नाही. यावर फेरफार नोंद क्र. १६४० मंजूर आहे.तसेच गा. न. नं. १२ मध्ये पिकांची माहिती देखील अद्ययावत झाली आहे तथापि अद्याप यावाबतचा बदल या ७/१२ वर घेण्यात आलेला नाही यांची कृपया नोंद घ्यावी.

७/१२ डाउनलोड दि. : ०७/०६/२०२२ : १२:०१:१६ PM. वैधता पडताळणीसाठी https://digitalsatbara.mahebhumi.gov.in/dslr/ या संकेत स्थळावर जाऊन 3202100001023693 हा क्रमांक वापरावा

पृष्ठ क्र



भारत सरकार

आधार - सामान्य माणसाचा अधिकार

भारत सरकार

41571

TRUE COPY
ADVOCATE

ANNEXURE-R-10

EXTEC

L&T-KOMATSU

ASHAPURA
MINECHEM LIMITED

Monday, October 23, 2017

Adarsh Crushers
At.Rovale,PostKelshi,
Tal.Dapoli, Ratnagiri.
PAN No.: AHDPJ0067C
GSTIN :27AHDPJ0067C1ZU
Kind Attn.: JunaidJalal Mob.No.9011196000
Sub :Work Order - Bauxite ROM Feeding, Crushing & Side Casting/Loading at Rovale andUmbershet Mines

Dear Sir,

With reference to above quote, we hereby offer you the work order to carry out above mentioned work at our Rovale and UmbershetMines,fortheperiod fromfromfrom1st November, 2017 to 31st May, 2019or till such period as instructed by AML representatives, with following terms and conditions :-

DEFINITIONS OF TERMS:

In the Work Order document as herein defined where the context so admits, the following words and expressions will have the following meanings:-

'CRUSHING PRODUCTS' shall mean all the specified crushed material is to be provided by Adarsh Crushers (AC) to AshapuraMinechem Ltd. Dapoli (AML-Dapoli), which is currently Bauxite Cruhsing.

Unless otherwise specifically stated, the masculine gender shall include the feminine and/or neutral gender and vice versa and the singular shall include the plural and vice versa.

1) SCOPE OF WORK, RATE & TAXES:

a) For (+) 10 mm to (-)100 mm – Rs.75/- MT + Goods & ServiceTax, Above cost is inclusive ofMobilization – Demobilization and all direct/ indirect expenses associated with the work
b) For Fines (-10mm)-Rs.10/- MT+Goods & ServiceTax (Payable for only transported quantity.The Stocked or side casted at backfilled quantity does not attract any payment)

To execute the above mentioned work you should have to provide the following machinery/Equipments fleet.

a) Jaw Crusher (200 TPH Capacity) : 1 Nos. Mobile Crusher
b) Excavator (Ready to Feed the Crusher) : 1 No.
c) Loader – (HM 2021 / or Equivalent) :1 Nos. (For Side Casting/Loading)

Regd. Office :
Jeevan Udyog Building, 3rd Floor, 278, D. N. Road, Fort, Mumbai - 400 001. (India)
Tel. : +91-22 6665 1700 Email : info@ashapura.com www.ashapura.com
CIN No. L14108MH1982PLC026396

Continuation Sheet

ASHAPURA

2) VALIDITY:

All the Crushing operations are to be stopped by 30th June, 2019, unless otherwise specially requested by our Site incharge to continue the operation.

3) PAYMENT TERMS:

AC shall be paid for providing services as per rates defined in the scope of work as per clause no.1.

This will be subjected to our quality and requirement. Payment for this material will be made only after dispatch of material to the port, based on final weight slip issued by concern Sakhari weighbridge. However if the cargo has not been dispatch for longer period then you will raise provisional crushing bill fortnightly based on survey done by in house surveyor with the help of Total Station / Theodolite with high accuracy by measuring the cargo during that period. Quantity assessed accordingly,80% payment on all materials will be made. Payment will be made within 15 - days from the time of submission of certified bills at **AML-Dapoli**. TDS will be deducted as per prevailing rates.

The value of Work Order is based on rate as per estimated quantity. However the payment shall be made by AML-Dapoli on the basis of actual quantity & rate applicable for the same. The value of Work Order is not binding on AML-Dapoli for any upward/downward revision, which may occur during the validity of the Work Order.

The rate shall also be valid for all quantities ordered under this Work Order till the validity of the Work Order and irrespective of the total of the order. Accordingly the final contract value to be determined on actual quantity handled.

4) COMPLIANCE WITH LAWS:

AC shall be subject to and shall comply with all applicable laws, rules, ordinances, regulations, executive orders of any government or governmental authority or agency having or asserting jurisdiction over the subject matter hereof, and expressed public policies. AChas agreed that it will not take any action that would be illegal or in violation of those applicable laws, rules, ordinances, regulations, executive orders and/or policies. All work of services performed and executed by AC, if any pursuant to this Work order shall be performed by AC in proper and workman like manner and as an independent contractor and not as the agent of AML-Dapoli. AC shall be responsible for compliance with all prevailing laws, rules and regulations, including but not limited to employment of labour hours of labours working conditions, worker's compensation, payment of wages and payment of taxes, and other payroll deductions, including applicable contributions from such persons when required by law.

5) INDEMNITY

AC hereby Indemnify and keep fully and effectively Indemnified and saved harmless AML-Dapoli, its subsidiaries, its directors, officers, employees, agents, authorized representatives, successors and assigns from and against all claims, suits, actions, legal and other proceedings,

demands, damages, liabilities, interest, attorney fees, costs, expenses and consequences of whatsoever nature of any kind including those arising or anywise relating to or in any manner caused or occasioned, directly or indirectly or contributed in whole or in part by reason of either non compliance of any laws and/or any act and/or omission and/or commission of any deed on the part of AC.

AC shall bear and pay all expenses including, for the avoidance of doubt, legal costs incurred by AML-Dapoli in responding to and defending all such claims, demands and actions. AC shall bear and promptly pay all penalties, interest, damages, claims and liabilities imposed, claimed or levied or assessed against AML-Dapoli, the subsidiaries, directors, officers, employees, agents, authorized representatives, successors, assigns and against all other persons claiming by through or under AML-Dapoli.

6) WEIGHMENT:

Quantity will be determined based on weigh slip issued at receiving Sakhari Weighbridge, which will be binding to both the parties & accordingly final bills will be raised by the contractor.

7) GENERAL: As under -

a) You will arrange all Crushing equipment like Jaw Crusher (200 TPH Capacity), Excavator(Ready to feed the crusher), Loader (HM2021/or Equivalent) etc. as per the requirement at your cost mentioned / asked by AML-Dapoli.Contractor's Hired equipments payment related disputes will be settled by Contractor themselves. Contractor should deploy adequate CrushingEquipmentstoperform the Crushing operation and Labor for sizing to meet the production requirements as per given schedule.Contractor should make all necessary arrangements at their own cost viz Labor accommodation, Diesel, safe drinking water etc.

b) You will arrange fuel and other lubricants.

c) Food and conveyance for your technical/ non- technical staff will be arranged and borne by you.

d) Bauxite ROM of ±600 MM to be given as feed for crushing by AML You will give sized output of 0-100 mm & the same would be side caste or loaded onto trucks/dumpers by you.

e) You must ensure that all crushing operations should be carried out in safe and hygienic working condition.

f) High grade ore excavated should be stacked separately and should not be contaminated with low grade ore without seeking permission of Mining officials.

g) You will obtain labour contract license and comply all statutory provisions so framed under contractual labour act, rules & regulations related to mining and related defined activities.

h) Crushing rates will only be revised, if there is any increase in diesel price beyond 15%.

Continuation Sheet

ASHAPURA

i) AML-Dapoli is not responsible for any damage to Human or Land of adjacent area by your workers /staff or Machine. Any claim in this regard will be borne and settled by you failing to the same AML-Dapoli will deduct the amount from your payment & directly pay.

j) Local and Government liasoningcost shall be borne by you.

k) You shall obtain NOC from the concerned local authority and submit to this office before commencement of work.

l) If Local authority have any objections & passes any resolution against the contractor & if deemed fit, company can terminate the contract at any given point without giving any notice.

m) Company can keep any numbers of contractors as per requirements.

n) **You shall not bring any third party for any kind of settlements of any nature.** You are supposed to settle all the issues directly with company.

o) **This contract award is not transferable. You are not allowed to give Sub –contract.**

p) Ones the contract is awarded you are not supposed to change the company name or firm name and the accounts, balances, credits or debits are not transferable and should not be sublet to any other sub contractor.

q) You shall furnish PAN (Permanent Account Number) for taxation purpose.

r) TDS will be deducted as per applicable rates.

s) You will charge the Goods &Servicetax on bill as per prevailing rates

t) Invoice to be raised on 10 days basis and payment will be made by AML within 15 days for the material transported as per the weigh bridge figure after making deductions i.e. Advance, diesel supplied and others if any.

u) Contractor has to take Goods &Servicetax registration & should fulfill all required formalities for the same. Liability of Goods &Servicetax or any other tax (P.F, ESIC etc.) will be born by you.No liability of any tax will be accepted by AML such as Goods & Goods & Service tax, P.F, ESIC etc..AlsoyoumustfollowGoods &ServiceTax Rules and Regulations viz. Goods &ServiceTax Payment & file Goods &ServiceTax Return and provide Goods &ServiceTax Registration Certificate. If any Notice's is issued from Goods &ServiceTax Department then contractors will be solely responsible for any shortcomings(GST Payment, GST Returns etc.). You will furnish Copy of Goods &ServiceTax Payment Challan at AML Office on regular basis.

v) Contractor shall submit to DGMS, Returns indicating a) Name of the Firm b) Registration No. c) Name & Address of Person heading the firm d) Nature of work e) Type of deployment of work person f) No. of work person deployed in which how many work person hold Vocational Training (VT) Certificate g) How many work person undergone Initial Medical Examination (IME) h) Type of Medical coverage given to the work person.

w) Bills produced against machineries utilized for Miscellaneous purpose must be submitted in time. Delayed bills will not be entertained.

x) **Safety :** 1) Manpower engaged must be physically fit and devoid of any diseases.
2) Personal protective equipment should either be provided by contractor or the same if provided by the company then the cost should be borne by the Contractor.

y) However, within 15days from date of this contact you shall submit the following documents to us: a) LabourLicence (if 20 & more labour) b)Provident Fund Registration No. c) Workmen compensation policy.

z) Contractor are required to maintained below records and register, which come under Provision of Contract Labour Act 1970. : a) Muster Roll b)Register of deductions c)Register of Overtime d) Register of Wages e) Register of Fines f)Register of Advance g)Identity card of Manpower h)Wages Slip i)Provident Fund deposited challan.

aa) The rate of wages payable to the workmen by the contractor shall not less than Minimum rates of wages fixed under the Minimum Wages Act.

bb) Contractor should not deploy his manpower which is below 18 years.

cc) Contractor must deposit the wages of their work persons in the bank account of the respective work persons.

dd) In case if Mining activities gets stopped for reasons beyond the control Mine Management (viz. Local Problems/Govt.Restrictions/Local Authorities), Crushing Contractor shall not be liable to claim any payment against Idle hours.

8) SUPERVISION:

a) You will place sufficient numbers of supervisors required to meet the quality aswell as Quantity.

b) Authorize a competent person who will be reporting to our Site in charge in your absence.

c) You should impart vocational training and initial medical examination to their employees.

d) You should provide personal protective equipment (PPE) to their employees to maintain their health and safety.

e) Crushing Operation will be carried out as per the instructions given by the AML-Dapoli – Site In charge (Mines Manager) or Representative.

9) RELATIONSHIP

AC is an independent contractor. Nothing in this Work Order shall be construed as creating any relationship with AML-Dapoli other than that of owner and independent contractor or as creating any relationship between AML-Dapoli and AC's related persons. Neither AC, nor any of its related persons, are or shall be deemed to be employees of AML-Dapoli.

10) CONFIDENTIALITY

During the period of this Work Order or for the further extended period of Work Order mutually, both AML-Dapoli and AC agree to treat this Work Order as confidential and shall not disclose/divulge to any third party any confidential /secret information including the brochures, circulars, policy guidelines and correspondence of AML-Dapoli with regard to the said work which may come to the knowledge of AC during the course of this execution of this Work Order and shall not use any part of this Agreement for any purpose other than the purpose of this Work Order.

11) COVENANT NOT TO COMPETE

AC agrees that during the period of time beginning with the execution of this Work Order and

ending one (1) years after termination/determination of this Work Order by efflux of time or otherwise, AC shall neither execute nor solicit work of similar nature directly and/or from other customers.

12) INSURANCE

AC will cover its own materials, Plant & Equipment, Tools & Tackles, Crushingequipments / materials, staff and laborers by appropriate insurance cover.

13) AMENDMENTS

Any Amendments to this Work Order shall be in writing and signed by the authorized representatives of the Parties.

14) NOTICES

All the notices or communications by either party to other party to this Work Order shall be sent in writing to the addresses as mentioned in this clause.
The parties Name, Address and Facsimile Numbers are as under;

ADARSH CRUSHERS - At.Rovale,PostKelshi,Tal.Dapoli, Ratnagiri.

ASHAPURA MINECHEM LIMITED - 986,Annab Villa, Dapoli MandangadRaod, Dapoli,Dist.Ratnagiti, Maharashtra

A notice given in accordance with this clause is deemed to be received.

i) If hand delivered, on delivery
ii) If sent by prepaid post, five (5) days after date of posting; or
iii) If sent by facsimile, when the sender's facsimile system generates a message confirming successful transmission of the total number of pages of the notice.

15) TERMINATION:

It is clarified that in case there is a default or any breach of laws by the AC as is specified, AML-Dapoli shall have the right to terminate the Contract forthwith by giving a notice of 7 - days.

Notwithstanding anything contained herein, this Agreement may be terminated / determined by either party by giving 1months' notice in writing at the AC's / AML-Dapoli address by Registered A/D to the other without assigning any reasons thereof.

Termination or determination of this Agreement howsoever occasion shall be without prejudice to the rights and obligations of the parties herein, incurred prior to the date of expiry and determination of the Agreement. It is also further agreed that upon termination/determination of

this agreement by efflux of time or otherwise AC shall hand/over deliver to AML-Dapoli the stock of Bauxite ore lying in their possession, control or custody.

All obligations hereunder incurred prior to and which by their nature would continue beyond the cancellation, termination or expiration of this Agreement shall survive such termination or expiration.

16) FORCE MAJEURE:

AC shall not be liable to AML-Dapoli nor shall AML-Dapoli be liable to AC for any delay, interruption or failure in the performance of obligations hereunder, if such delay, interruption or failure is due to or results from war (whether declared or undeclared), revolution, insurrection, military mobilization, civil commotion, riot, Act of God, and embargoes. Both parties agree to endeavor to minimize the effect of Force Majeure conditions to whatever extent they can & mutually agree on alternative courses of action either in anticipation of or after Force Majeure conditions after the normalcy is restored. The party whose performance is so prevented or delayed shall promptly give notice to the other party with, if possible, supporting evidence and shall take reasonable steps to make good and resume its performance with least possible delay, provided however that events or occurrences which could be foreseen/ anticipated and/ or avoided by exercise of due diligence and normal commercial prudence shall not be considered as Force Majeure conditions, even if falling under any of the conditions above.

17) ARBITRATION:

The Parties hereto shall endeavor to settle all disputes and differences relating to and/or arising out of the Contract amicably. In the event of the Parties failing to resolve any dispute amicably the same shall be referred to Arbitration in accordance with the Arbitration and Conciliation Act 1996, as is prevalent in India. Each Party shall be entitled to nominate an Arbitrator and the two Arbitrators so nominated shall jointly nominate a third presiding Arbitrator. The Arbitrators shall give a reasoned award. The place of arbitration shall be Mumbai and the language of the arbitration shall be English. The Parties further agree that any arbitration award shall be final and binding upon the Parties. The Parties hereto agree that the AC shall be obliged to carry out its obligations under the Contract even in the event a dispute is referred to Arbitration.

18) GOVERNING LAW:

This Contract shall be construed in accordance with and governed by the laws of India and in the event of any litigation the courts in Mumbai shall have exclusive jurisdiction.

Form of Agreement

Please sign both copies, return one signed hardcopy to us and retain one for your records. Receipt of an executed copy will serve as notice to proceed.

For AshapuraMinechem Limited	**For Adarsh Crushers**
Girisha Hegade- AGM Operations	**Junaid Jalal - Authorized Signatory**

ASHAPURA
MINECHEM LIMITED

Friday, November 1, 2019

To,
Gurukrupa Minerals
At. Post Chandgad, Shivaji Galli,
Tal. Chandgad, Kolhapur

Kind Attn.: Mr. Gajanan D. Pilankar /Mr. Sudesh Dattatray Sapale Mob: +91 9422428220

Sub.: Amendment to the Work Order issued on dated 23rd October 2017 for Bauxite ROM Feeding, Crushing & Side Casting/Loading at Rowale and Umbershet Mines.
PAN No.: AAKFG3445P GSTIN: 27AAKFG3445P1ZU

Ref: Crushing Work Order issued on 23rd October 2017 & 19th September 2018

Dear Sir,

With reference to the above, we are pleased to renew the work order dated 23.10.2017 & 19.09.2018 effective from 01.11.2019 to 31st May 2020 with the following revised Crushing contract Rates.

1) SCOPE OF WORK, RATE & TAXES:

a) For (+) 10 mm to (-) 100 mm - Rs.80/- PMT + Goods & Service Tax, inclusive of Mobilization – Demobilization and all direct/ indirect expenses associated with the work
b) For Fines (-10mm) - Rs.10/- MT + Goods & Service Tax (Payable for only transported quantity. The Stocked or side casted at backfilled quantity does not attract any payment).

All other terms and conditions of the contract documents dated 23/10/2017 & 19/09/2018, shall remain unchanged. You are kindly requested to start mobilization of your equipment's, manpower etc. latest by 4th November 2019.

Kindly sign and return duplicate of this letter in token of your acceptance.

Thanking you,

Yours Faithfully
for **ASHAPURA MINECHEM LIMITED**

01/11/2019

GIRISH HEGADE
AGM-OPERATION

GAJANAN PILANKAR/SUDESH SAPALE
GURUKRUPA MINERALS

ASHAPURA
MINECHEM LIMITED

Date : October 29,2017

To,
Gurukrupa Minerals
At. Post Chandgad, Shivaji Galli, Tal. Chandgad, Kolhapur

Kind Attn.: Mr. Gajanan D. Pilankar /Mr. Sudesh Dattatray Sapale Mob: +91 9422428220
Sub.: Amendment to the Work Order issued on dated 23rd October 2017 for Bauxite ROM Feeding, Crushing & Side Casting/Loading at Rowale and Umbershet Mines.

Dear Sudeshji,

This will confirm our understanding to amend work order dated 23/10/2017 for Crushing contract services at specified location.

1) SCOPE OF WORK, RATE & TAXES:

a) For (+) 10 mm to (-) 100 mm - Rs.75/- PMT + Service Tax, exclusive of Mobilization – One way Mobilization charges will be paid extra as actual at the mutually agreed cost.

All other terms and conditions of the contract documents dated 23/10/2017, shall remain unchanged. You are kindly requested to start mobilization of your equipment, manpower etc. latest by 30th October 2017.
Kindly sign and return duplicate of this letter in token of your acceptance.
Thanking you,
Yours Faithfully
for **ASHAPURA MINECHEM LIMITED**

GIRISH HEGADE
AGM-OPERATION

GAJANAN PILANKAR/SUDESH SAPALE
GURUKRUPA MINERALS

onday, October 23, 2017

Gurukrupa Minerals
At.PostChandgad, ShivajiGalli, Tal.Chandgad, Kolhapur

ASHAPURA MINECHEM LIMITED

Kind Attn.: Mr. GajananD.Pilankar /SudeshDattatraySapale Mob: +91 9421428929
PAN No.: AAKFG3445P GSTIN.: 27AAKFG3445P1ZU
Sub:WorkOrder - Bauxite ROM Feeding, Crushing & Side Casting/Loading at Rowale and Umbershet Mines

Dear Sir,

With reference to above quote, we hereby offer you the work order to carry out above mentioned work at our Rovale and UmbershetMines,for the period from from1st November, 2017 to 31st May, 2019or till such period as instructed by AML representatives, with following terms and conditions :-

DEFINITIONS OF TERMS:

In the Work Order document as herein defined where the context so admits, the following words and expressions will have the following meanings:-

'CRUSHING PRODUCTS' shall mean all the specified crushed material is to be provided by Gurukrupa Minerals (GM) to Ashapura Minechem Ltd. Dapoli (AML-Dapoli), which is currently Bauxite Crushing.

Unless otherwise specifically stated, the masculine gender shall include the feminine and/or neutral gender and vice versa and the singular shall include the plural and vice versa.

1) SCOPE OF WORK, RATE & TAXES:

a) For (+) 10 mm to (-) 100 mm – Rs.75/- MT + Goods &Service Tax, above cost is inclusive ofMobilization and all direct/ indirect expenses associated with the work.

b) For Fines (-10mm)-Rs.10/- MT+Goods &ServiceTax(Payable for only transported quantity.The Stocked or side casted and backfilled quantity does not attract any payment)

To execute the above mentioned work you should have to provide the following machinery/Equipments fleet.

a) Jaw Crusher (400 TPH Capacity) : 2 No. Mobile Crusher
b) Excavator (Ready to Feed the Crusher) : 2 No.
c) Loader – (HM 2021 or Equivalent) :2 No. (For Side Casting/Loading)

Regd. Office :
Jeevan Udyog Building, 3rd Floor, 278, D. N. Road, Fort, Mumbai - 400 001. (India)
Tel. : +91-22 6665 1700 Email : info@ashapura.com www.ashapura.com
CIN No. L14108MH1982PLC026396

ASHAPURA

2) VALIDITY:

All the Crushing operations are to be stopped by 30th June 2019, unless [illegible] requested by our Site incharge to continue the operation.

3) PAYMENT TERMS:

GM shall be paid for providing services as per rates defined in the scope of work as per clause no.1.

This will be subjected to our quality and requirement. Payment for this material will be made only after dispatch of material to the port, based on final weight slip issued by concern Sakhari weighbridge. However if the cargo has not been dispatch for longer period then you will raise provisional crushing bill fortnightly based on survey done by our in house surveyor with the help of Total Station / Theodolite with high accuracy by measuring the cargo during that period. Quantity assessed accordingly and 80% payment on all materials will be made. Payment will be made within 15 - days from the time of submission of certified bills at **AML-Dapoli**. TDS and other taxes would be at as per prevailing rates.

The value of Work Order is based on rate as per estimated quantity. However the payment shall be made by AML-Dapoli on the basis of actual quantity & rate applicable for the same. The value of Work Order is not binding on AML-Dapoli for any upward/downward revision, which may occur during the validity of the Work Order.

The rate shall also be valid for all quantities ordered under this Work Order till the validity of the Work Order and irrespective of the total of the order. Accordingly the final contract value to be determined on actual quantity handled.

4) COMPLIANCE WITH LAWS:

GM shall be subject to and shall comply with all applicable laws, rules, ordinances, regulations, executive orders of any government or governmental authority or agency having or asserting jurisdiction over the subject matter hereof, and expressed public policies. GMhas agreed that it will not take any action that would be illegal or in violation of those applicable laws, rules, ordinances, regulations, executive orders and/or policies. All work of services performed and executed by GM, if any pursuant to this Work order shall be performed by GM in proper and workman like manner and as an independent contractor and not as the agent of AML-Dapoli. GM shall be responsible for compliance with all prevailing laws, rules and regulations, including but not limited to employment of labor hours of labors working conditions, worker's compensation, payment of wages and payment of taxes, and other payroll deductions, including applicable contributions from such persons when required by law.

5) INDEMNITY

GM hereby Indemnify and keep fully and effectively Indemnified and saved harmless AML-Dapoli, its subsidiaries, its directors, officers, employees, agents, authorized representatives, successors and assigns from and against all claims, suits, actions, legal and other proceedings,demands, damages, liabilities, interest, attorney fees, costs, expenses and consequences of whatsoever nature of any kind including those arising or anywise relating to or in any manner caused or occasioned, directly or indirectly or contributed in whole or in part by reason of either non compliance of any laws and/or any act and/or omission and/or commission of any deed on the part of GM.

GM shall bear and pay all expenses including, for the avoidance of doubt, legal costs incurred by AML-Dapoli in responding to and defending all such claims, demands and actions. GM shall bear and promptly pay all penalties, interest, damages, claims and liabilities imposed, claimed or levied or assessed against AML-Dapoli, the subsidiaries, directors, officers, employees, agents, authorized representatives, successors, assigns and against all other persons claiming by through or under AML-Dapoli.

6) WEIGHMENT:

Quantity will be determined based on weigh slip issued at receiving Sakhari Weighbridge, which will be binding to both the parties & accordingly final bills will be raised by the contractor.

7) GENERAL: As under -

a) You will arrange all Crushing equipment like Jaw Crusher (400 TPH Capacity), Excavator(Ready to feed the crusher), Loader (HM2021/or Equivalent) etc. as per the requirement at your cost mentioned / asked by AML-Dapoli.Contractor's Hired equipments payment related disputes will be settled by Contractor themselves. Contractor should deploy adequate CrushingEquipmentstoperform the Crushing operation and Labor for sizing to meet the production requirements as per given schedule.Contractor should make all necessary arrangements at their own cost *viz* Labor accommodation, Diesel, safe drinking water etc.

b) You will arrange fuel and other lubricants.

c) Food and conveyance for your technical/ non- technical staff will be arranged and borne by you.

d) Bauxite ROM of ±600 MM to be given as feed for crushing by AML You will give sized output of 0-100 mm & the same would be side caste or loaded onto trucks/dumpers by you.

e) You must ensure that all crushing operations should be carried out in safe and hygienic working condition.

f) High grade ore excavated should be stacked separately and should not be contaminated with low grade ore without seeking permission of Mining officials.

g) You will obtain labor contract license and comply all statutory provisions so framed under contractual labor act, rules & regulations related to mining and related defined activities.

ASHAPURA

h) Crushing rates will only be revised, if there is any increase in diesel price beyond 15%.

i) AML-Dapoli is not responsible for any damage to Human or Land of adjacent area by your workers /staff or Machine. Any claim in this regard will be borne and settled by you failing to the same AML-Dapoli will deduct the amount from your payment & directly pay.

j) Local and Government liaisoncost shall be borne by you.

k) You shall obtain NOC from the concerned local authority and submit to this office before commencement of work.

l) If Local authority have any objections & passes any resolution against the contractor & if deemed fit, company can terminate the contract at any given point without giving any notice.

m) Company can keep any numbers of contractors as per requirements.

n) You shall not bring any third party for any kind of settlements of any nature.Youare supposed to settle all the issues directly with company.

o) This contract award is not transferable. You are not allowed to give Sub –contract.

p) Ones the contract is awarded you are not supposed to change the company name or firm name and the accounts, balances, credits or debits are not transferable and should not be sublet to any other sub contractor.

q) You shall furnish PAN (Permanent Account Number) for taxation purpose.

r) TDS will be deducted as per applicable rates.

s) You will charge the service tax on bill as per prevailing rates

t) Invoice to be raised on 10 days basis and payment will be made by AML within 15 days for the material transported as per the weigh bridge figure after making deductions i.e. Advance, diesel supplied and others if any.

u) Contractor has to take Goods & Servicetax registration & should fulfill all required formalities for the same. Liability of Goods & Servicetax or any other tax (P.F, ESIC etc.) will be born by you.No liability of any tax will be accepted by AML such as Goods & Goods & Service tax, P.F, ESIC etc..Also youmustfollow Goods & ServiceTax Rules and Regulations viz. Goods & ServiceTax Payment & file Goods & ServiceTax Return and provide Goods & ServiceTax Registration Certificate. If any Notice's is issued from Goods & ServiceTax Department then contractors will be solely responsible for any shortcomings(GST Payment, GST Returns etc.). You will furnish Copy of Goods & ServiceTax Payment Challan at AML Office on regular basis.

v) Contractor shall submit to DGMS, Returns indicating a) Name of the Firm b) Registration No. c) Name & Address of Person heading the firm d) Nature of work e) Type of deployment of work person f) No. of work person deployed in which how many work person hold Vocational Training (VT) Certificate g) How many work person undergone Initial Medical Examination (IME) h) Type of Medical coverage given to the work person.

w) Bills produced against machineries utilized for Miscellaneous purpose must be submitted in time. Delayed bills will not be entertained.

x) **Safety :** 1) Manpower engaged must be physically fit and devoid of any diseases.
2) Personal protective equipment should either be provided by contractor or the same if provided by the company then the cost should be borne by

the Contractor.

y) However, within 15days from date of this contact you shall submit the following documents to us: a) LabourLicence (if 20 & more labour) b)Provident Fund Registration No. c) Workmen compensation policy.
z) Contractor are required to maintained below records and register, which come under Provision of Contract Labour Act 1970. : a) Muster Roll b)Register of deductions c)Register of Overtime d) Register of Wages e) Register of Fines f)Register of Advance g)Identity card of Manpower h)Wages Slip i)Provident Fund deposited challan.
aa) The rate of wages payable to the workmen by the contractor shall not less than Minimum rates of wages fixed under the Minimum Wages Act.
bb) Contractor should not deploy his manpower which is below 18 years.
cc) Contractor must deposit the wages of their work persons in the bank account of the respective work persons.
dd) In case if Mining activities gets stopped for reasons beyond the control Mine Management (viz. Local Problems/Govt.Restrictions/Local Authorities), Crushing Contractor shall not be liable to claim any payment against Idle hours.

8) SUPERVISION:

a) You will place sufficient numbers of supervisors required to meet the quality aswell as Quantity.
b) Authorize a competent person who will be reporting to our Site in charge in your absence.
c) You should impart vocational training and initial medical examination to their employees.
d) You should provide personal protective equipment (PPE) to their employees to maintain their health and safety.
e) Crushing Operation will be carried out as per the instructions given by the AML-Dapoli – Site In charge (Mines Manager) or Representative.

9) RELATIONSHIP

GM is an independent contractor. Nothing in this Work Order shall be construed as creating any relationship with AML-Dapoli other than that of owner and independent contractor or as creating any relationship between AML-Dapoli and GM's related persons. Neither GM, nor any of its related persons, are or shall be deemed to be employees of AML-Dapoli.

10) CONFIDENTIALITY

During the period of this Work Order or for the further extended period of Work Order mutually, both AML-Dapoli and GM agree to treat this Work Order as confidential and shall not disclose/divulge to any third party any confidential /secret information including the brochures, circulars, policy guidelines and correspondence of AML-Dapoli with regard to the said work which may come to the knowledge of GM during the course of this execution of this Work Order and shall not use any part of this Agreement for any purpose other than the purpose of this Work Order.

11) COVENANT NOT TO COMPETE

GM agrees that during the period of time beginning with the execution of this Work Order and ending one (1) years after termination/determination of this Work Order by efflux of time or otherwise, GM shall neither execute nor solicit work of similar nature directly and/or from other customers.

Continuation Sheet

ASHAPURA

12) INSURANCE

GM will cover its own materials, Plant & Equipment, Tools & Tackles, Crushingequipments / materials, staff and laborers by appropriate insurance cover.

13) AMENDMENTS

Any Amendments to this Work Order shall be in writing and signed by the authorized representatives of the Parties.

14) NOTICES

All the notices or communications by either party to other party to this Work Order shall be sent in writing to the addresses as mentioned in this clause.
The parties Name, Address and Facsimile Numbers are as under;

GURUKRUPA MINERALS–At.PostChandgad, ShivajiGalli, Tal.Chandgad, Kolhapur.

ASHAPURA MINECHEM LIMITED - 986,Annab Villa, Dapoli Mandangad Road, Dapoli,Dist. Ratnagiri, Maharashtra

A notice given in accordance with this clause is deemed to be received.

i) If hand delivered, on delivery
ii) If sent by prepaid post, five (5) days after date of posting; or
iii) If sent by facsimile, when the sender's facsimile system generates a message confirming successful transmission of the total number of pages of the notice.

15) TERMINATION:

It is clarified that in case there is a default or any breach of laws by the GM as is specified, AML-Dapoli shall have the right to terminate the Contract forthwith by giving a notice of 7 - days.

Notwithstanding anything contained herein, this Agreement may be terminated / determined by either party by giving 1months' notice in writing at the GM's / AML-Dapoli address by Registered A/D to the other without assigning any reasons thereof.

Termination or determination of this Agreement howsoever occasion shall be without prejudice to the rights and obligations of the parties herein, incurred prior to the date of expiry and determination of the Agreement. It is also further agreed that upon termination/determination of this agreement by efflux of time or otherwise GM shall hand/over deliver to AML-Dapoli the stock of Bauxite ore lying in their possession, control or custody.

All obligations hereunder incurred prior to and which by their nature would continue beyond the cancellation, termination or expiration of this Agreement shall survive such termination or expiration.

16) FORCE MAJEURE:

GM shall not be liable to AML-Dapoli nor shall AML-Dapoli be liable to GM for any delay, interruption or failure in the performance of obligations hereunder, if such delay, interruption or failure is due to or results from war (whether declared or undeclared), revolution, insurrection, military mobilization, civil commotion, riot, Act of God, and embargoes. Both parties agree to endeavor to minimize the effect of Force Majeure conditions to whatever extent they can & mutually agree on alternative courses of action either in anticipation of or after Force Majeure conditions after the normalcy is restored. The party whose performance is so prevented or delayed shall promptly give notice to the other party with, if possible, supporting evidence and shall take reasonable steps to make good and resume its performance with least possible delay, provided however that events or occurrences which could be foreseen/ anticipated and/ or avoided by exercise of due diligence and normal commercial prudence shall not be considered as Force Majeure conditions, even if falling under any of the conditions above.

17) ARBITRATION:

The Parties hereto shall endeavor to settle all disputes and differences relating to and/or arising out of the Contract amicably. In the event of the Parties failing to resolve any dispute amicably the same shall be referred to Arbitration in accordance with the Arbitration and Conciliation Act 1996, as is prevalent in India. Each Party shall be entitled to nominate an Arbitrator and the two Arbitrators so nominated shall jointly nominate a third presiding Arbitrator. The Arbitrators shall give a reasoned award. The place of arbitration shall be Mumbai and the language of the arbitration shall be English. The Parties further agree that any arbitration award shall be final and binding upon the Parties. The Parties hereto agree that the GM shall be obliged to carry out its obligations under the Contract even in the event a dispute is referred to Arbitration.

18) GOVERNING LAW:

This Contract shall be construed in accordance with and governed by the laws of India and in the event of any litigation the courts in Mumbai shall have exclusive jurisdiction.

Form of Agreement

Please sign both copies, return one signed hardcopy to us and retain one for your records. Receipt of an executed copy will serve as notice to proceed.

For Ashapura Minechem Limited	**For Gurukrupa Minerals**
Deepak Shende –AGM-Operations	**SudeshSapale / GajananPilankar - Authorized Signatory**

TRUE COPY ADVOCATE

ANNEXURE-R-11

F. No. J-11015/417/2013-IA-II(M) **Speed Post**
Government of India
Ministry of Environment, Forest & Climate Change
Impact Assessment Division

3rd Floor, Vayu Wing,
Indira Paryavaran Bhawan,
Jorbagh Road, Aliganj,
New Delhi-110 003
E-mail: sridhar-mef@nic.in
Tele: 011-24695304

Dated: 24th February, 2016

To,

M/s Ashapura Minechem Limited
278, D.N. Road, Jeevan Udyog Building,
3rd Floor, Fort, Mumbai-400001

E-mail rbp@ashapura.com
Tele/Fax No. 022-2207 9395

Sub.: Rowale Bauxite Mine of M/s Ashapura Minechem Limited located at village Rowale, Taluka Dapoli, District Rantnagiri, Maharashtra (218.285ha) for expansion of Bauxite Mining from 2.5 LTPA to 8.0 LTPA-Environmental Clearance regarding.

Reference: Online Application IA/MH/MIN/20610/2013

Sir,

This has reference to your online application for the above mentioned proposal for mining for expansion of Bauxite Mining from 2.5 LTPA of Bauxite to 8.0 LTPA from 218.285 ha Mine lease area located at Village-Rowale, Taluka Dapoli, District Ratnagiri in Maharashtra . The Survey No 15-21, 27-31, 34-35, 56-59, 69, 70 & 74 of Rowale Village. The latitude and longitude of the site are 73° 04' 42.07"E to 17°54' 41.77"N and 73^0 06' 38.50" E to 17^0 54' 37.70"N.

2. The proposal was considered in the EAC meeting held during 16– 17ht December 2013 and further considered in EAC meeting held during May 28th-30th, 2014. TOR was issued vide MoEF Lr. No J-11015/417/2013-IA.II (M) dated 15th July 2014. The Certified Compliance report of prior Environmental Clearance dated 31.10.2008 no. J-11015/274/2007-IA. II(M) was also submitted and discussed during the meeting. The proposal was appraised before the Expert Appraisal Committee in its Meeting held during September 22-24, 2015 wherein the Committee recommended the proposal for Environmental Clearance for Mining of proposed production capacity of Bauxite Mining from 2.5 LTPA of Bauxite to 8.0 LTPA.

3. The mine lease area is 218.285 ha which, is a private non-forest waste land. There is no forest land in the lease area. The Scheme of Mining with PMCP for years 2010 -11 to 2014 – 15 is approved vide IBM Lr No: MS/RTNG/GOA (MAH)/BX-50-SZ/325 dated 01/07/2011. The latest scheme of mining for the project is approved for 2015-16 to 2019-20 by IBM vide Lr. No MSH/MECH-84 (MAH)/GOA/2014-15 dated 20.07.2015.

4. The open cast mechanized mining method will be adopted to operate the

lease area. Average depth of the pit is 6 mts and average height of the bench will be maintained up to 6 m depend upon the depth of bauxite deposit. Since, the maximum annual production is 8,00,000 tpa, the fully mechanized mining method will be followed during the plan. Mining Plan for production and development Bench will have slope angle of 650. Access road will be taken to the pit area. Pits will be roughly rectangular in shape and will have box like appearances after the excavation; 2-3 faces may be worked simultaneously for handling during present scheme period; however it is envisaged in future based on outcome of proposed exploration. Drilling / blasting combination will be adopted to loosen the ore. The operations involved are drilling by using 115 mm dia drilling machine, for drilling holes of 5 to 6 mts depth. Blasting will be done using slurry explosives in conjunction with delay detonators. Loosened ore will be excavated and loaded into the tipper by hydraulic excavator. Tipper will transport the ore to the processing plant. Ore will be crushed here. Processed ore will be loaded into trucks for destination. The Life of the mine is 12 years.

5. It is reported by the PP that total Geological & inferred reserves are 11.618 million tonnes and mineable Reserves: 8.897 million tonnes. Conceptual mine development will be carried out in 155.21 ha, area for green belt will be 6.89 ha, roads will occupy 1.49 ha & statutory buildings will occupy 0.01 ha, Area for future development will be 54.88 ha. About 80 KLD of water will be required which will be sourced through Ground water.

6. It was reported by the PP that the surface topographical elevation is 320m MSL to 50m MSL. The water table in the locality is at a depth of 15- 20 m below the surface level within lease area. The mine workings are expected to reach to a depth of 6 m. Hence, mining activities will not intersect ground water table.

7. It was reported by the PP that there is no wildlife sanctuary/tiger reserve/national park, etc. within the 10 km radius area around the mine lease. As per the survey carried out, no Schedule – I species is reported in the study area. The Baseline studies were carried out during post monsoon 2014 by M/s Bhagavathi Ana Labs Pvt. Ltd. All the parameters for air, water, and noise quality were reported to be within prescribed standards. The Public Hearing for the Rowale Bauxite Mine was conducted on 07.05.2015 at Mines office of Ashapura Minechem Ltd at Umbershet Village. The PH was chaired by Shri. B. Radhakrishnan, District Collector. The issues raised during public hearing were also considered and discussed during the meeting, which inter-alia, included that proponent should take road development and maintenance into consideration and villagers should be taken into confidence and employment should be given to locals instead of outsiders. As per the villager's requirements, it was informed by the PP that they would take care of local issues. These have been incorporated in the Project Plan with budgetary provisions.

8. The cost of the project is Rs 4.65 Crores. Capital budget for environmental protection measures is Rs57.50 lakhs and recurring cost is Rs 47.70 lakhs. Out of the above cost CSR cost: (Rs Lakhs: Capital Rs: 17.50 + Recurring Rs12.20). It was reported by the PP that there is no court case/litigation pending against the project.

9. The Ministry of Environment, Forests & Climate Change has examined the proposal in accordance with the Environmental Impact Assessment Notification, 2006 and further amendments thereto and hereby accords the environmental

clearance under the provisions thereof to the above mentioned proposal of **Rowale Bauxite Mine of M/s Ashapura Minechem Limited located at village Rowale Taluka Dapoli, Dist. Rantnagiri, Maharashtra (218.285ha) for expansion of Bauxite Mining from 2.5LTPA to 8.0 LTPA,** subject to compliance of the followings terms and conditions and environmental safeguards mentioned below:-

A. Specific conditions

(i) Environmental clearance is granted subject to final outcome of Hon'ble Supreme Court of India, Hon'ble High Court of Maharashtra and any other Court of Law, if any, as may be applicable to this project.

(ii) Environmental clearance is subject to obtaining clearance, if any, under the Wildlife (Protection) Act, 1972 from the Competent Authority, as may be applicable to this project.

(iii) No mining activities will be allowed in forest area, if any, for which the Forest Clearance is not available.

(iv) The Project Proponent shall obtain Consent to Operate from the State Pollution Control Board, Maharashtra and effectively implement all the conditions stipulated therein.

(v) A study from an Institution of Repute may be conducted on the impact of Bauxite dust on Crop Productivity in agricultural land located around mines and mitigation measures to be implemented by PP to reduce the impact.

(vi) Recommendation by the Institute, for Crops most suited in this environment and training to the farmers to switch over to new cropping system which will sustain nutrient loading.

(vii) Proponent shall carry out Occupational Health surveillance for workers engaged in the Project and records maintained and necessary remedial/preventive measures to be taken accordingly. Implementation of the Recommendations of National Institute for ensuring good occupational environment for mine workers.

(viii) Use of mechanical devices for excavating the ore shall be promoted and reducing use of explosives.

(ix) Concurrent reclamation of mined out areas shall be done.

(x) Use of effective sprinkler system to suppress fugitive dust on haul roads and other transfer points and undertaking comprehensive study in a years' time for slope stabilization of mine benches and OB dumps shall be undertaken.

(xi) Implementation of Action Plan on the issues raised during the Public Hearing. The Proponent shall complete all the tasks as per the Action Plan submitted with the budgetary provisions during the Public Hearing.

(xii) The mining operations shall be restricted to above ground water table and it should not intersect groundwater table. Prior approval of the Ministry of Environment, Forest & Climate Change and Central Ground Water Authority shall be obtained for mining below water table.

(xiii) The project proponent shall ensure that no natural watercourse shall be obstructed due to any mining operations.

(xiv) Top soil should be stacked with proper slope at earmarked site(s) only with adequate measures and should be used for reclamation and rehabilitation of mined out areas.

(xv) The entire waste generated shall be backfilled and there shall be no external over burden dump left at the end of the mine life. The entire backfilled area shall be reclaimed by plantation. The back filling should be carried out in such a manner that it is restored to the normal ground level. Monitoring and

management of rehabilitated areas should continue until the vegetation becomes self-sustaining. Compliance status should be submitted to the Ministry of Environment, Forest & Climate Change and its Regional Office, Nagpur on six monthly basis.

(xvi) Catch drains and siltation ponds of appropriate size should be constructed for the working pit, temporary OB dumps, if any and mineral dumps to arrest flow of silt and sediment. The water so collected should be utilized for watering the mine area, roads, green belt development etc. The drains should be regularly desilted, particularly after monsoon, and maintained properly.

(xvii) Garland drain of appropriate size, gradient and length shall be constructed for both mine pit and temporary dumps and sump capacity should be designed keeping 50% safety margin over and above peak sudden rainfall (based on 50 years data) and maximum discharge in the area adjoining the mine site. Sump capacity should also provide adequate retention period to allow proper settling of silt material. Sedimentation pits should be constructed at the corners of the garland drains and desilted at regular intervals.

(xviii) Dimension of the retaining wall at the toe of temporary dumps and OB benches within the mine to check run-off and siltation should be based on the rain fall data.

(xix) Plantation shall be raised in the specified area including a 7.5m wide green belt in the safety zone around the mining lease by planting the native species around ML area, backfilled and reclaimed area, around water body, roads etc. in consultation with the local DFO/Agriculture Department. The density of the trees should be around 2500 plants per ha.

(xx) Regular water sprinkling should be carried out in critical areas prone to air pollution and having high levels of SPM and RSPM such as haul road, loading and unloading point and transfer points. It should be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.

(xxi) The project authority should implement suitable conservation measures to augment ground water resources in the area in consultation with the Regional Director, Central Ground Water Board.

(xxii) Regular monitoring of ground water level and quality should be carried out in and around the mine lease by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring should be carried out four times in a year i.e. January, April-May, August, November and the data thus collected may be sent regularly to Ministry of Environment, Forest & Climate Change, its Regional Office, Nagpur; Central Ground Water Authority and Central Ground Water Board.

(xxiii) Vehicular emissions should be kept under control and regularly monitored. Measures shall be taken for maintenance of vehicles used in mining operations and in transportation of mineral. The vehicles should be covered with a tarpaulin and shall not be overloaded.

(xxiv) Blasting operation should be carried out only during the daytime. Controlled blasting should be practiced. The mitigative measures for control of ground vibrations and to arrest fly rocks and boulders should be implemented.

(xxv) Drills shall either be operated with dust extractors or equipped with water injection system.

(xxvi) A Final Mine Closure Plan along with details of Corpus Fund should be submitted to the Ministry of Environment, Forest & Climate Change 5 years in advance of final mine closure for approval.

B. General Conditions

(i) No change in mining technology and scope of working should be made without prior approval of the Ministry of Environment, Forest & Climate Change.

(ii) No change in the calendar plan including excavation, quantum of mineral and waste should be made.

(iii) The Project Proponent shall obtain necessary prior permission of the competent authorities for drawl of requisite quantity of surface water and ground water for the project.

(iv) Regular monitoring of ground water table to be carried out at the upstream and depth of water available in the dug well is to be measured. Monitoring to be done by establishing a network of existing wells and constructing new piezometers.

(v) Monitoring of Ambient Air Quality to be carried out based on the 2009 Notification, as amended from time to time by the Central Pollution Control Board. Water sprinkling should be increased at places loading and unloading points & transfer point to reduce fugitive emissions.

(vi) The upliftment of scheduled caste/scheduled tribe population, specific programmes have been taken in to consideration specially with respect to education, health care, livelihood generation, infrastructure development & promotion of sports & culture for SC/ST population and that these will be intensified in future.

(vii) Plantation shall be raised in a 7.5m wide green belt in the safety zone around the mining lease, backfilled and reclaimed area, around water body, along the roads etc. by planting the native species in consultation with the local DFO/Agriculture Department. The density of the trees should be around 2500 plants per ha. Greenbelt shall be developed all along the mine lease area in a phased manner and shall be completed within first five years.

(viii) Dimension of the retaining wall at the toe of over burden dumps and OB benches within the mine to check run-off and siltation shall be based on the rain fall data.

(ix) Effective safeguard measures such as regular water sprinkling shall be carried out in critical areas prone to air pollution and having high levels of PM_{10} and $PM_{2.5}$ such as haul road, loading and unloading point and transfer points. It shall be ensured that the Ambient Air Quality parameters conform to the norms prescribed by the Central Pollution Control Board in this regard.

(x) Regular monitoring of the flow rate of the springs and perennial nallahs flowing in and around the mine lease shall be carried out and records maintained. Regular monitoring of water quality upstream and downstream of water bodies shall be carried out and record of monitoring data should be maintained and submitted to the Ministry of Environment, Forest & Climate Change, its Regional Office, Nagpur, Central Groundwater Authority, Regional Director, Central Ground Water Board, State Pollution Control Board and Central Pollution Control Board.

(xi) Regular monitoring of ground water level and quality shall be carried out in and around the mine lease by establishing a network of existing wells and constructing new piezometers during the mining operation. The monitoring shall be carried out four times in a year – pre- monsoon (April-May), monsoon (August), post-monsoon (November) and winter (January) and the data thus collected may be sent regularly to Ministry of Environment, Forest & Climate Change and its Regional Office, Nagpur, Central Ground Water Authority and Regional Director, Central Ground Water Board.

(xii) The critical parameters such as PM_{10} (size less than 10 micro meter), $PM_{2.5}$ (size less than 2.5 micro meter), NO_x in the ambient air within the impact zone, peak particle velocity at 300m distance or within the nearest habitation, whichever is closer shall be monitored periodically. Further, quality of discharged water shall also be monitored [(TDS, DO, PH and Total Suspended Solids (TSS)]. The monitored data shall be uploaded on the website of the company as well as displayed on a display board at the project site at a suitable location near the main gate of the Company in public domain. The circular No. J-20012/1/2006-IA.II (M) dated 27.05.2009 issued by Ministry of Environment, Forest & Climate Change, which is available on the website of the Ministry www.envfor.nic.in shall also be referred in this regard for its compliance.

(xiii) Four ambient air quality-monitoring stations should be established in the core zone as well as in the buffer zone for PM_{10}, $PM_{2.5}$, SO_2 & NO_x monitoring. Location of the stations should be decided based on the meteorological data, topographical features and environmentally and ecologically sensitive targets and frequency of monitoring should be undertaken in consultation with the State Pollution Control Board. Data on ambient air quality should be regularly submitted to the Ministry including its Regional office located at Nagpur and the State Pollution Control Board / Central Pollution Control Board once in six months.

(xiv) Fugitive dust emissions from all the sources should be controlled regularly. Water spraying arrangement on haul roads, loading and unloading and at transfer points should be provided and properly maintained.

(xv) Measures should be taken for control of noise levels below 85 dBA in the work environment. Workers engaged in operations of HEMM, etc. should be provided with ear plugs / muffs.

(xvi) Industrial waste water (workshop and waste water from the mine) should be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May, 1993 and 31st December, 1993 or as amended from time to time. Oil and grease trap should be installed before discharge of workshop effluents.

(xvii) Personnel working in dusty areas should wear protective respiratory devices and they should also be provided with adequate training and information on safety and health aspects.

(xviii) Occupational health surveillance program of the workers should be undertaken periodically to observe any contractions due to exposure to dust and take corrective measures, if needed.

(xix) A separate environmental management cell with suitable qualified personnel should be set-up under the control of a Senior Executive, who will report directly to the Head of the Organization.

(xx) The funds earmarked for environmental protection measures should be kept in separate account and should not be diverted for other purpose. Year wise expenditure should be reported to the Ministry and its Regional Office located at Nagpur.

(xxi) The project authorities should inform to the Regional Office located at Nagpur regarding date of financial closures and final approval of the project by the concerned authorities and the date of start of land development work.

(xxii) The Regional Office of this Ministry located at Nagpur shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information / monitoring reports.

(xxiii) The Project Proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment, Forest & Climate Change, its Regional Office, Nagpur, Central Pollution Control Board and State Pollution Control Board.

(xxiv) The project proponent shall submit six monthly report on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment, Forest and Climate Change, its Regional Office, Nagpur, Central Pollution Control Board and State Pollution Control Board.

(xxv) A copy of clearance letter will be marked to concerned Panchayat / local NGO, if any, from whom suggestion / representation has been received while processing the proposal.

(xxvi) State Pollution Control Board should display a copy of the clearance letter at the Regional office, District Industry Centre and Collector's office/ Tehsildar's Office for 30 days.

(xxvii) The project authorities should advertise at least in two local newspapers widely circulated, one of which shall be in the vernacular language of the locality concerned, within 7 days of the issue of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution Control Board and also at web site of the Ministry of Environment, Forest & Climate Change at **http://envfor.nic.in** and a copy of the same should be forwarded to the Regional Office of this Ministry located Nagpur.

10. The Ministry or any other Competent Authority may alter/modify the above conditions or stipulate any further condition in the interest of environment protection.

11. Concealing factual data or submission of false/fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of the Environment (Protection) Act, 1986.

12. The above conditions will be enforced inter-alia, under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986 and the Public Liability Insurance Act, 1991 along with their amendments and rules made there under and also any other orders passed by the Hon'ble Supreme Court of India/ High Court of Maharashtra and any other Court of Law relating to the subject matter.

13. Any appeal against this environmental clearance shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

(Dr. U. Sridharan)
Scientist 'F'

Copy to:

(i) The Secretary, Ministry of Mines, Government of India, Shastri Bhawan, New Delhi-110 001.

(ii) The Secretary, Department of Mines & Geology, Govt. of Maharashtra, Mantralaya, Mumbai.

(iii) The Secretary, Department of Environment, Govt. of Maharashtra, Mantralaya, Mumbai.
(iv) The Secretary, Department of Forests, Govt. of Maharashtra, Mantralaya, Mumbai
(v) The Additional Principal Chief Conservator of Forests, Regional Office (WCZ), Ministry of Environment, Forest and Climate Change, Nagpur
(vi) The Chairman, Central Pollution Control Board, Parivesh Bhavan, CBD-cum-Office complex, East Arjun Nagar, New Delhi-1100032.
(vii) The Member Secretary, Central Ground Water Authority, A-2, W3, Curzon Road Barracks, K.G. Marg, New Delhi-110001.
(viii) The Chairman, Maharashtra Pollution Control Board, Kalpatru Point, Sion Circle, Sion (East), Mumbai-400 022, Maharashtra.
(ix) The Controller General, Indian Bureau of Mines, Indira Bhavan, Civil Lines, Nagpur-440 001.
(x) The District Collector, Rantnagiri, District, of Maharashtra.
(xi) Guard File.

(Dr. U. Sridharan)
Scientist 'F'

ANNEXURE-R-12

MAHARASHTRA POLLUTION CONTROL BOARD

Phone : 24010437/24014701/24020781
Fax : 24024068/24023516
Website: http://mpcb.gov.in.
E-Mail: jdair @mpcb.gov.in

KALPATARU POINT, 3rd Floor,
Sion-Matunga Scheme Rd. No.8,
Opp. Sion Circle, Sion (East),
Mumbai-400 022.

RED/SSI

Consent No. BO/JD(APC)/EIC No. EIC No.KP-18257-16/O/ 10273 **Date:** 21/10/**2016**

Consent to Operate under Section 26 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorisation / Renewal of Authorisation under Rule 5 of the Hazardous Wastes (Management, Handling & Transboundary) Rules , 2008.

[To be referred as Water Act, Air Act and HW (M,H & TM) Rules respectively].

CONSENT is hereby granted to,

M/s Ashapura Minechem Ltd.,
Gut No. 15-21, 27-31,34-35, 56-59, 69,70,74,
Vill- Rowale, Tal-Dapoli, Dist- Ratnagiri.

located in the area declared under the provisions of the Water Act, Air act and Authorization under the provisions of HW(M&H) Rules and amendments thereto subject to the provisions of the Act and the Rules and the Orders that may be made further and subject to the following terms and conditions:

1. **The Consent to Operate is granted for a period up — 30/04/2019.**

2. **The Consent is valid for the following –**

Sr.No.	Product/Activity	Maximum Quantity
1	Mining of Bauxite Ore including mobile crushing & Screening activity	8,00,000 MT/A

(Mining lease area of 218.285 hectares)

3. **CONDITIONS UNDER WATER ACT:**

(i) The daily quantity of trade effluent from the Mine shall be **Nil**

(ii) The daily quantity of sewage effluent from the factory shall not exceed 2.4m³.

(iii) **Trade Effluent Treatment:** NA

(iv) **Trade Effluent Disposal:**NA

(v) **Sewage Effluent Treatment:** The applicant shall provide comprehensive treatment system as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated effluent to the following standards.

(1)Suspended Solids Not to exceed 100 mg/l.
(2)BOD 3 days 27° C. Not to exceed 100 mg/l.

(vi) **Sewage Effluent Disposal:** The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

(vii) **Non-Hazardous Solid Wastes:**

Sr. No.	Type Of Waste	Quantity	UOM	Treatment	Disposal
1	Waste Bauxite Ore Mineral	0.62	Lac MT/A	---	Sale

Maharashtra Pollution Control Board Mumbai

(viii) **Other conditions:** The industry shall monitor effluent quality regularly.

4. The applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Cess Act, 1977 (to be referred as Cess Act) and Amended Rules, 2003 there under:
Water consumption for the following categories is as under:

Sr No	Consumption	Quantity
1	Domestic	8.0 CMD
2	Mine Discharge	0.0 CMD
3	dust Suppression	60.0 CMD
4	Other uses like gardening Etc	12.0 CMD

The applicant shall regularly submit to the Board the returns of water consumption in the prescribed form and pay the Cess as specified under Section 3 of the said Act.

5. **CONDITIONS UNDER AIR ACT:**

(I) The applicant shall install a comprehensive control system consisting of control equipments as is warranted with reference to generation of emission and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards:

(A) Standards for Emissions of Air Pollutants:

(i) TPM Not to exceed 150 mg/Nm^3

(B) Control Equipment:

(i) Raw material handling plant/ Bauxite plant shall be provided with Dust Collector and Automatic Water Sprinkler.

(ii) Scientific spraying of water on all working area, dump area, stock piles with the help of appropriate dust suppression system.

(iii) Raw materials & Finished products shall be properly covered during transportation.

(iv) The applicant shall carry out tree plantation along road side, around dumps or Compulsory a forestation as per proposal approved by Forest Department. The tree plantation programme shall be taken up well in advance of the actual mining activity, so that green belt of sufficient width and height is developed between mining area/road and surrounding environment.

(v) Metalled roads shall be provided and well maintained to prevent dust formation.

(vi) Overloading of dumpers shall be avoided to prevent spillages.

(vii) Correct type and quantity of explosive shall be used to avoid excess dust formation and vibration in the surrounding area.

(viii) The slope of the over burden shall have slope but not more than 28 degree to the horizontal. The overburden shall be properly covered by vegetation for Stabilization.

(ix) Bauxite ore/mineral transportation shall be done by installing conveyors wherever possible & covered closed trucks shall be used for transportation.

Crusher Conditions:

1. Dust containment-cum-suppression system for the equipment.
2. Crushing unit, sieve, conveyor belt and fall of material shall be covered with metal sheets.
3. Construction of metal roads within the premises.
4. Growing of green belt along the periphery.
5. Regular cleaning & wetting of the ground within the premises.

(II) **The applicant shall observe the following fuel pattern:-**

Sr.No.	Type of Fuel	Quantity

Maharashtra Pollution Control Board

(III) **The applicant shall erect the chimney(s) of the following specifications:-**

Sr.No.	Chimney attached to	Height in Mtrs.

(IV) The applicant shall provide minimum three ambient air quality monitoring stations within mining area which should be monitored for SPM, RSPM, SO_2, NOx, HC, CO etc. The Annual Arithmetic Mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval shall conform to the National Ambient Air Quality Standards prescribed under Air (Prevention and Control of Pollution) Act, 1981 and Environment (Protection) Act, 1986. The records of results of continuous monitoring done shall be made available for inspection to the officers of the Board.

(V) The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

(VI) **Other Conditions:**

Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipments, the production process connected to it shall be stopped.

6. CONDITIONS UNDER HW (M,H &TM) RULES, 2008:

(i) The applicant shall handle hazardous wastes as specified below:

Sr.No.	Item No. as per Sch-I	Type of Waste	Quantity	Disposal
Industry shall not generate any hazardous waste				

7. General conditions:

(i) The applicant shall bring minimum 33% of the available open land under green coverage/ plantation. The applicant shall submit a yearly statement by 30th September every year on available open plot area, no. of trees surviving as on 31st March of the year and no. of trees planted by September end.

(ii) The applicant shall provide for an alternate electric power source sufficient to operate all pollution control facilities installed by he applicant and operate the same in case of power failure to maintain compliance with the terms and conditions of the consent. In the absence of same, the applicant shall stop, reduce or otherwise, control production to abide by terms & conditions of this consent regarding pollution levels.

(iii) The applicant shall not change or alter quantity, quality, the rate of discharge, temperature or the mode of the effluent/ emissions or hazardous wastes or control equipments provided for without previous written permission of the Board.

(v) The firm shall submit MPCB, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as pre the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992 before 30th September every year.

(vi) The applicant shall install a separate meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained. The applicant shall also submit a comparative statement of designed power and chemical consumptions vis-a

Maharashtra Pollution Control Board

vis actual power and chemical consumption alongwith Environmental statement.

(vii) Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes/sewers down- stream of the terminal manholes. No effluent shall find its way other than in designed and provided collection system. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.

(viii) The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous wastes to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf. An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.

(viii) The industry shall ensure that fugitive emissions from the activity are controlled so as to maintain clean and safe environment in and around the factory premises.

(ix) The applicant shall maintain good house keeping and take adequate measures for control of pollution from all sources so as not to cause nuisance to surrounding area / inhabitants. The project authorities shall work out the feasibility of deploying mechanically closed trucks for transportation and submit action plan within 3 months.

8. The project authorities shall submit an action plan for using closed mineral/metal conveyor belt system in place of truck transportation, wherever the coal transportation distances is less than 3 Kilometers initially, within 3 months.

9. The project authorities shall identify critical road sections where the dust generated from mineral metal transportation is likely to affect human population and/or agriculture and take up works of making those roads pucca and clean, so as to reduce dust emissions in 3 months.

10. The project authorities shall install well designed water sprinkling arrangements including fixed and mobile sprayers for dust suppression. The augmentation/ up gradation proposal for dust suppression system shall be submitted in 3 months.

11. The project authorities shall give suitable training to field level mine personnel and truck drivers on environmental protection and pollution control.

12. This Board reserves the right to amend or add any conditions in this consent and the same shall be binding on the Applicant.

13. This Board reserves the right to review, amend, suspend, revoke etc. this consent and the same shall be binding on the industry.

14. This consent should not be construed as exemption from obtaining necessary NOC/permission from any other Government agencies.

15. The industry shall extend the existing Bank Guarantee of Rs. 2.0 & to submit additional BG of Rs-3.0 Lakhs within 15 days period towards operation and maintenance of pollution control system. Both Bank Guarantee's shall be valid upto 30/09/2019.

Maharashtra Pollution Control Board ★ Mumbai ★

Maharashtra Pollution Control Board

16. **The industry shall comply with the conditions of Environmental Clearance granted by Ministry of Environment, Forest & Climate Change, Govt. of India, New Delhi vide No. J-11015/417/2013-IA-II (M), dated 24/02/2016.**

17. **The consent granted is an overriding effect to the earlier consent granted vide No. MPCB/ROK/SROC/193/03450/14, dated 09.04.2014.**

18. **This consent is granted without prejudice of the order passed or being passed by the Hon'ble National Green Tribunal (WZ) Pune for the case No. 74 of 2016.**

19. **It is obligatory on the part of the Project proponent to restrict the mining operations above ground water table & it should not intersect ground water table without obtaining prior approval of MoEF & Climate Change, GoI & Central Ground Water Authority for mining below water table. This condition should be binding in respect of existing valid consent as well as first consent to operate for expansion of mining operations, which is being amalgamated in the existing consent to Operate dated 09.04.2014.**

20. **The unit shall obtain NOC from CGWA before start of expansion.**

21. **Total Capital investment of the Mine is Rs. 4.85 Crs.**

Maharashtra Pollution Control Board Mumbai

For and On Behalf of the
Maharashtra Pollution Control Board,

(Dr. V.M.Motghare) 21/7/16
Joint Director (Air Pollution Control)

To,
M/s Ashapura Minechem Ltd.,
Gut No. 15-21, 27-31,34-35, 56-59, 69,70,74,
Vill- Rowale, Tal-Dapoli, Dist- Ratnagiri.

Copy to:

1) Regional Officer, MPCB, Kolhapur: **You are directed to extend the BG of Rs. 2.0 lakh & to obtain additional BG of Rs-3.0 Lakh, as per consent condition No. 15 above & to monitor the JVS parameter for first 3 months along with submission of report on monthly basis to this office.**

2) Sub-Regional Officer, MPCB, Chiplun : For necessary followup.

3) Chief Accounts Officer, MPCB, Mumbai.

Received Consent fee of –

Sr. No.	Amount(Rs.)	DD. No.	Date	Drawn On
1	Rs.2, 35,000/-	52016042800805058	28/04/2016	Bank of Baroda

4) Cess Branch, MPCB. 5) Master file.

Maharashtra Pollution Control Board

MAHARASHTRA POLLUTION CONTROL BOARD

Phone : 24010437/24014701/24020781
Fax : 24024068/24023516
Website: http://mpcb.gov.in.
E-Mail: jdair @mpcb.gov.in

KALPATARU POINT, 3rd Floor,
Sion-Matunga Scheme Rd. No.8,
Opp. Sion Circle, Sion (East),
Mumbai-400 022.

RED/SSI

Consent No. BO/JD(APC)/UAN No.66905/O/CC-1178 **Date: 26/ 11 / 2019**

Consent to Operate under Section 26 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorisation / Renewal of Authorisation under Rule 5 of the Hazardous Wastes (Management, Handling & Transboundary) Rules , 2008.

[To be referred as Water Act, Air Act and HW (M,H & TM) Rules respectively].

CONSENT is hereby granted to,

M/s Ashapura Minechem Ltd.,
Gut No. 15-21, 27-31,34-35, 56-59, 69,70,74,
Vill- Rowale, Tal-Dapoli, Dist- Ratnagiri.

located in the area declared under the provisions of the Water Act, Air act and Authorization under the provisions of HW(M&H) Rules and amendments thereto subject to the provisions of the Act and the Rules and the Orders that may be made further and subject to the following terms and conditions:

1. **The Consent to Operate is granted for a period up — 30/04/2021.**

2. **The Consent is valid for the following –**

Sr.No.	Product/Activity	Maximum Quantity
1	Mining of Bauxite Ore including mobile crushing & Screening activity	8,00,000 MT/A

(Mining lease area of 218.285 hectares)

3. **CONDITIONS UNDER WATER ACT:**

(i) The daily quantity of trade effluent from the Mine shall be **Nil**

(ii) The daily quantity of sewage effluent from the factory shall not exceed 2.4m³.

(iii) **Trade Effluent Treatment:** NA

(iv) **Trade Effluent Disposal:**NA

(v) **Sewage Effluent Treatment:** The applicant shall provide comprehensive treatment system as is warranted with reference to influent quality and operate and maintain the same continuously so as to achieve the quality of treated effluent to the following standards.

(1)Suspended Solids Not to exceed 100 mg/l.
(2)BOD 3 days 27° C. Not to exceed 100 mg/l.

(vi) **Sewage Effluent Disposal:** The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

(vii) **Non-Hazardous Solid Wastes:**

Sr. No.	Type Of Waste	Quantity	UOM	Treatment	Disposal
1	Waste Bauxite Ore Mineral	0.62	Lac MT/A	---	Sale

Maharashtra Pollution Control Board

(viii) **Other conditions:** The industry shall monitor effluent quality regularly.

4. The applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Cess Act, 1977 (to be referred as Cess Act) and Amended Rules, 2003 there under:
Water consumption for the following categories is as under:

Sr No	Consumption	Quantity
1	Domestic	8.0 CMD
2	Mine Discharge	0.0 CMD
3	dust Suppression	60.0 CMD
4	Other uses like gardening Etc	12.0 CMD

The applicant shall regularly submit to the Board the returns of water consumption in the prescribed form and pay the Cess as specified under Section 3 of the said Act.

5. **CONDITIONS UNDER AIR ACT:**

(I) The applicant shall install a comprehensive control system consisting of control equipments as is warranted with reference to generation of emission and operate and maintain the same continuously so as to achieve the level of pollutants to the following standards:

(A) Standards for Emissions of Air Pollutants:

(i) TPM Not to exceed 150 mg/Nm^3

(B) Control Equipment:

(i) Raw material handling plant/ Bauxite plant shall be provided with Dust Collector and Automatic Water Sprinkler.

(ii) Scientific spraying of water on all working area, dump area, stock piles with the help of appropriate dust suppression system.

(iii) Raw materials & Finished products shall be properly covered during transportation.

(iv) The applicant shall carry out tree plantation along road side, around dumps or Compulsory a forestation as per proposal approved by Forest Department. The tree plantation programme shall be taken up well in advance of the actual mining activity, so that green belt of sufficient width and height is developed between mining area/road and surrounding environment.

(v) Metalled roads shall be provided and well maintained to prevent dust formation.

(vi) Overloading of dumpers shall be avoided to prevent spillages.

(vii) Correct type and quantity of explosive shall be used to avoid excess dust formation and vibration in the surrounding area.

(viii) The slope of the over burden shall have slope but not more than 28 degree to the horizontal. The overburden shall be properly covered by vegetation for Stabilization.

(ix) Bauxite ore/mineral transportation shall be done by installing conveyors wherever possible & covered closed trucks shall be used for transportation.

Crusher Conditions:

1. Dust containment-cum-suppression system for the equipment.
2. Crushing unit, sieve, conveyor belt and fall of material shall be covered with metal sheets.
3. Construction of metal roads within the premises.
4. Growing of green belt along the periphery.
5. Regular cleaning & wetting of the ground within the premises.

Maharashtra Pollution Control Board

(II) **The applicant shall observe the following fuel pattern:-**

Sr.No.	Type of Fuel	Quantity

(III) **The applicant shall erect the chimney(s) of the following specifications:-**

Sr.No.	Chimney attached to	Height in Mtrs.

(IV) The applicant shall monitor the parameters such as SPM, RSPM, SO_2, NOx, HC, CO etc. to conform to the National Ambient Air Quality Standards prescribed under Air (Prevention and Control of Pollution) Act, 1981 and Environment (Protection) Act, 1986. The records of results of Ambient Air Quality Monitoring shall be made available for inspection to the officers of the Board.

(V) The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB(A) during day time and 70 dB(A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.

(VI) **Other Conditions:**

Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipments, the production process connected to it shall be stopped.

6. CONDITIONS UNDER HW (M,H &TM) RULES, 2008:

(i) The applicant shall handle hazardous wastes as specified below:

Sr.No.	Item No. as per Sch-I	Type of Waste	Quantity	Disposal
Industry shall not generate any hazardous waste				

7. General conditions:

(i) The applicant shall bring minimum 33% of the available open land under green coverage/ plantation. The applicant shall submit a yearly statement by 30th September every year on available open plot area, no. of trees surviving as on 31st March of the year and no. of trees planted by September end.

(ii) The applicant shall provide for an alternate electric power source sufficient to operate all pollution control facilities installed by he applicant and operate the same in case of power failure to maintain compliance with the terms and conditions of the consent. In the absence of same, the applicant shall stop, reduce or otherwise, control production to abide by terms & conditions of this consent regarding pollution levels.

(iii) The applicant shall not change or alter quantity, quality, the rate of discharge, temperature or the mode of the effluent/ emissions or hazardous wastes or control equipments provided for without previous written permission of the Board.

(v) The firm shall submit MPCB, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as pre the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992 before 30th September every year.

(vi) Industry shall operate & maintain septic tank followed by soak pit regularly.

(vii) Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of collection system with arrangement for measuring the flow. No effluent shall be

Maharashtra Pollution Control Board

admitted in the pipes/sewers down- stream of the terminal manholes. No effluent shall find its way other than in designed and provided collection system. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.

(viii) The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous wastes to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf. An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.

(viii) The industry shall ensure that fugitive emissions from the activity are controlled so as to maintain clean and safe environment in and around the factory premises.

(ix) The applicant shall maintain good housekeeping and take adequate measures for control of pollution from all sources so as not to cause nuisance to surrounding area / inhabitants.

8. The project authorities shall identify critical road sections where the dust generated from mineral metal transportation is likely to affect human population and/or agriculture and take up works of making those roads pucca and clean, wherever is possible.

9. The project authority shall install mobile water sprinkling arrangement for dust suppression.

10. The project authorities shall give suitable training to field level mine personnel and truck drivers on environmental protection and pollution control.

11. This Board reserves the right to amend or add any conditions in this consent and the same shall be binding on the Applicant.

12. This Board reserves the right to review, amend, suspend, revoke etc. this consent and the same shall be binding on the industry.

13. This consent should not be construed as exemption from obtaining necessary NOC/permission from any other Government agencies.

14. The industry shall extend the existing Bank Guarantee of Rs. 2.0 lakhs & Rs.3.0 lakhs within 15 days period towards operation and maintenance of pollution control system. Both Bank Guarantee's shall be valid upto 31/08/2021.

16. The industry shall comply with the conditions of Environmental Clearance granted by Ministry of Environment, Forest & Climate Change, Govt. of India, New Delhi vide No. J-11015/417/2013-IA-II (M), dated 24/02/2016.

17. This consent is granted without prejudice of the order passed or being passed by the Hon'ble National Green Tribunal (WZ) Pune for the case No. 74 of 2016.

Maharashtra Pollution Control Board

18. **It is obligatory on the part of the Project proponent to restrict the mining operations above ground water table & it should not intersect ground water table without obtaining prior approval of MoEF & Climate Change, GoI & Central Ground Water Authority for mining below water table.**

19. **The industry shall comply the conditions stipulated in NOC issued by Central Ground Water Authority dated 18/12/2017.**

20. **Total Capital investment of the Mine is Rs. 5.57/- Crs.**

For and On Behalf of the
Maharashtra Pollution Control Board,

(Dr. V.M.Motghare) 26/11/19.
Joint Director (Air Pollution Control)

To,
M/s Ashapura Minechem Ltd.,
Gut No. 15-21, 27-31,34-35, 56-59, 69,70,74,
Vill- Rowale, Tal-Dapoli, Dist- Ratnagiri.

Copy to:

1) Regional Officer, MPCB, Kolhapur: **You are directed to extend the BG of Rs. 2.0 lakh & BG of Rs-3.0 Lakh, as per consent condition & to monitor the JVS parameter for first 3 months along with submission of report on monthly basis to this office.**

2) Sub-Regional Officer, MPCB, Chiplun : For necessary followup.

3) Chief Accounts Officer, MPCB, Mumbai.

Received Consent fee of –

Sr. No.	Amount(Rs.)	DD. No.	Date	Drawn On
1	Rs.17,25,000 /-	19113302790	23/04/2019	Bank of Baroda
2	Rs.5,000/-	19134613546	14/05/2019	Bank of Baroda

Note- The balance fees of Rs.10,35,000/- will be considered during next renewal of Consent.

4) Cess Branch, MPCB.
5) Master file.

Maharashtra Pollution Control Board

MAHARASHTRA POLLUTION CONTROL BOARD

Tel: 24010706/24010437
Fax:
24044532/4024068/4023516
Website: http://mpcb.gov.in
Email: jdair@mpcb.gov.in

Kalpataru Point, 2nd and 4th floor, Opp. Cine Planet Cinema, Near Sion Circle, Sion (E), Mumbai-400022

RED/S.S.I (R35)
No:- Format1.0/APAE Section/UAN No.MPCB-CONSENT-0000110617/CR / CC - 397

Date: 07/12/2021

To,
Ashapura Minchem Limited
Gut No.15-21, 27-31, 34-35, 56-59, 69, 70,74,
Village- Rowale, Tal - Dapoli, Dist - Ratnagiri

Your Service is Our Duty

Sub: **Renewal of Consent under RED Category**

Ref:
1. Earlier Consent granted by the Board vide Consent No. BO/JD(APC)/UAN No.66905/O/CC-1178, dated 26/11/2019 valid upto 30/04/2021
2. Your application for grant of renewal of consent vide UAN No. 110617

Your application No.MPCB-CONSENT-0000110617 Dated 12.03.2021

For: Grant of Consent to Operate under Section 26 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization under Rule 6 of the Hazardous & Other Wastes (Management & Transboundary Movement) Rules 2016 is considered and the consent is hereby granted subject to the following terms and conditions and as detailed in the schedule I, II, III & IV annexed to this order:

1. **The consent to renewal is granted for a period up to 30/04/2024**
2. **The capital investment of the project is Rs.5.57 Crs. (As per C.A Certificate submitted by industry)** 06/12/2021
3. **Consent is valid for the manufacture of:**

Sr No	Product	Maximum Quantity	UOM
Products			
1	Bauxite Ore	800000	MT/A

(Mining lease area of 218.285 hectares)

4. **Conditions under Water (P&CP), 1974 Act for discharge of effluent:**

Sr No	Description	Permitted (in CMD)	Standards to	Disposal Path
1.	Trade effluent	0	As per Schedule-I	Not Applicable
2.	Domestic effluent	2.4	As per Schedule-I	On land for gardening

Maharashtra Pollution Control Board Mumbai

5. **Conditions under Air (P& CP) Act, 1981 for air emissions:**

Sr No.	Stack No.	Description of stack / source	Number of Stack	Standards to be achieved
1	0	NA	0	As per Schedule -II

6. **Non-Hazardous Wastes:**

Sr No	Type of Waste	Quantity	UoM	Treatment	Disposal
1	Waste Bauxite Ore Mineral	0.62	MTPA	NA	Sale to authorized party

7. **Conditions under Hazardous & Other Wastes (M & T M) Rules 2016 for treatment and disposal of hazardous waste:**

Sr No	Category No./ Type	Quantity	UoM	Treatment	Disposal
NA					

Industry shall not generate any Hazardous Waste.

8. The Board reserves the right to review, amend, suspend, revoke etc. this consent and the same shall be binding on the industry.
9. This consent should not be construed as exemption from obtaining necessary NOC/permission from any other Government authorities
10. The applicant shall comply with the conditions of the Environmental Clearance granted by MoEF, New Delhi vide letter F. No.J-11015/417/2013-IA-II(M) dtd. 24/02/2016
11. PP shall carry out plantation as per EC condition before ensuing monsoon.
12. PP shall provide treatment plant for mine water discharge and submit sedimentation tank design details.
13. PP shall comply with the conditions stipulated in NOC issued by Central Ground Water Authority vide dtd. 08/12/2019 valid upto 07/12/2021 and shall obtain renewal of same time to time.
14. Industry shall extend all existing BGs towards O&M of pollution control systems and towards compliance of the Consent conditions.
15. This consent is granted without prejudice of the order passed or being passed by the Hon'ble National Green Tribunal (WZ) Pune for the case No. 74 of 2016.
16. It is obligatory on the part of the Project proponent to restrict the mining operations above ground water table & it should not intersect ground water table without obtaining prior approval of MoEF & Climate Change, GoI & Central Ground Water Authority for mining below water table.
17. PP shall provide minimum four ambient air quality monitor stations within area within period of Six months which should monitor the parameters such as SPM, RSPM, SO2, NOx, HC, CO etc. to conform to the National Ambient Air Quality Standards prescribed under Air (Prevention and Control of Pollution) Act, 1981 and Environment (Protection) Act, 1986. Bank Guarantee of Rs.2/- lakhs shall be submitted within 15 days towards the compliance of the same.
18. PP shall inform to the Board before starting mining operations and Regional Officer shall ensure the compliances of consent conditions and Pollution Control Systems provided by industry and submit the compliance report.

06/12/21

Maharashtra Pollution Control Board

19. The applicant shall make an application for renewal of consent 60 days prior to date of expiry of the consent. (Operate/Renewal)

For and on behalf of the
Maharashtra Pollution Control Board.

(Dr.V.M.Motghare) 05/12/2019
Joint Director (Air Pollution Control)

Received Consent fee of -

Sr.No	Amount(Rs.)	Transaction/DR.No.	Date	Transaction Type
As per Consent granted vide dated 26/11/2019 balance fees was Rs.10,35,000/- with Board and same is considered upto 30/04/2024.				

Copy to:

1. Regional Officer, MPCB, Kolhapur and Sub-Regional Officer, MPCB, Chiplun
   - They are directed to ensure the compliance of the consent conditions.
2. Chief Accounts Officer, MPCB,Sion, Mumbai

Maharashtra Pollution Control Board MAHARASHTRA Mumbai

SCHEDULE-I

Terms & conditions for compliance of Water Pollution Control:

1. A] Generation - As per your application the treated effluent generation is Nil.
   B] Treatment - NA
   C] Disposal - NA

2. A] As per your application, you have provided Septic Tank followed by Soak pit for the treatment of 2.4 CMD of sewage.

   B] The Applicant shall operate the sewage treatment system to treat the sewage so as to achieve the following standards.

Sr.No	Parameters	Standards (mg/l)	
1	BOD (3 days 27°C)	Not to exceed	100 mg/l
2	Suspended Solids	Not to exceed	100 mg/l.

   C] The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

3. The Board reserves its rights to review plans, specifications or other data relating to plant setup for the treatment of waterworks for the purification there of & the system for the disposal of sewage or trade effluent or in connection with the grant of any consent conditions. The Applicant shall obtain prior consent of the Board to take steps to establish the unit or establish any treatment and disposal system or an extension or addition thereto.

4. The industry shall ensure replacement of pollution control system or its parts after expiry of its expected life as defined by manufacturer so as to ensure the compliance of standards and safety of the operation thereof.

5. The Applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Act, 1974 and as amended, by installing water meters and other provisions as contained in the said act:

Sr. No.	Purpose for water consumed	Water consumption quantity (CMD)
1.	Industrial Cooling, spraying in mine pits or boiler feed	60.00
2.	Domestic purpose	8.00
3.	Processing whereby water gets polluted & pollutants are easily biodegradable	0.00
4.	Processing whereby water gets polluted & pollutants are not easily biodegradable and are toxic	0.00
5.	Gardening	12

6. The Applicant shall provide Specific Water Pollution control system as per the conditions of EP Act, 1986 and rule made there under from time to time/ Environmental Clearance/ CREP guidelines.

06/12/2021

Maharashtra Pollution Control Board

SCHEDULE-II

Terms & conditions for compliance of Air Pollution Control:

1. As per your application, you have provided the Air pollution control (APC) system and erected following stack (s) to observe the following fuel pattern:

Stack No.	Source	APC System provided/proposed	Stack Height(in mtr)	Type of Fuel	Sulphur Content(in %)	Pollutant	Standard
0	NA		0.00	0 0 -- NA--	-	TPM	150 Mg/Nm^3

2. The Applicant shall provide Specific Air Pollution control equipments as per the conditions of EP Act, 1986 and rule made there under from time to time/ Environmental Clearance / CREP guidelines.
3. The Applicant shall obtain necessary prior permission for providing additional control equipment with necessary specifications and operation thereof or alteration or replacement/alteration well before its life come to an end or erection of new pollution control equipment.
4. The Board reserves its rights to vary all or any of the condition in the consent, if due to any technological improvement or otherwise such variation (including the change of any control equipment, other in whole or in part is necessary).
5. Control Equipments
   a. Scientific spraying of water on all working area, dump area, stock piles with the help of appropriate dust suppression system.
   b. Minerals shall be properly covered during transportation.
   c. The applicant shall carry out tree plantation along road side, around dumps or compulsory afforestation as per proposal approved by Forest Department. The tree plantation programme shall be taken up well in advance of the actual mining activity, so that green belt of sufficient width & height is developed between mining area/road and surrounding environment.
   d. Black topped metal roads provided shall be well maintained to prevent dust formation.
   e. Overloading of dumpers shall be avoided to prevent spillages.
   f. Correct type & quantity of explosive shall be used to avoid excess dust formation & vibration in the surrounding area.
   g. The slope of the over burden shall have slope not more than 28° to the horizontal. The overburden shall be properly covered by vegetation for stabilization.
   h. Bauxite Ore / Minerals transportation shall be done by installing conveyors wherever possible & mechanically covered closed trucks shall be used for transportation.
   i. Dust containment-cum-suppression system for the equipment.
6. Standards for Ambient Air Pollutants:

   The Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_x) concentration in downwind direction considering predominant wind direction, at a distance of 500 metres from the following dust generating sources shall not exceed the standards specified in the table given below:

   Dust Generating Sources:

   Loading or unloading, Haul Road, coal transportation road, Coal handling plant (CHP), Railway Sliding, Blasting, Drilling, Overburden dumps, or any other dust generating external sources like coke ovens (hard as well as soft), briquette industry, nearby road etc

06/12/21

Maharashtra Pollution Control Board MAHARASHTRA Mumbai

Pollutant	Time weighted average	Concentration in Ambient Air
Suspended Particulates Matter (SPM)	Annual Average	360 µg/m^3
	24 hours	500 µg/m^3
Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average	180 µg/m^3
	24 hours	250 µg/m^3
Sulphur Dioxide (SO_2)	Annual Average	80 µg/m^3
	24 hours	120 µg/m^3
Oxides of Nitrogen as NO_x	Annual Average	80 µg/m^3
	24 hours	120 µg/m^3

i. In case of any residential or commercial or industrial place falls within 500 metres of any dust generating sources, the National Ambient Air Quality Standards notified vide MOEFCC GOI notification dtd 16.11.2009 as ammended shall be made applicable.

ii. The applicant shall provide minimum three ambient air quality monitoring stations within mining area which should be monitored for SPM, RSPM, SO_2, NOx, HC, CO etc. The Annual Arithmetic Mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval shall conform to the National Ambient Air Quality Standards prescribed under Air (Prevention and Control of Pollution) Act, 1981 and Environment (Protection) Act, 1986. The records of results of monitoring done shall be made available for inspection to the officers of the Board.

7. The applicant shall take adequate measures for control of noise levels from its own sources as follows:

Sr. No	Location	Permissible Norms [in dB (A)]	Desired minimum thickness of green belt (m)
1.	Along Road side	65 (Commercial Area)	20
2.	In colonies	55 (Residential Area)	20
3.	Near Opencast Mines	75 (Industrial Area)	10
4.	Near CHPs	75	30
5.	Near Shaft	75	20.
6.	Near Mine exhaust fan	75	> 50

8. Other conditions:

i Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess standards laid down, such information shall be forthwith reported to Board, concerned Police station, office of Directorate of Health services, Dept. of explosives, Inspectorate of Factories & Local Body. In case of failure of pollution control equipments, the production process connected to it shall be stopped.

06/12/2021

Maharashtra Pollution Control Board

SCHEDULE-III
Details of Bank Guarantees:

Sr. No.	Consent (C2E/ C2O /C2R)	Amt of BG Imposed	Submission Period	Purpose of BG	Compliance Period	Validity Date
1	Renewal of Consent	Rs.5/- lakhs	15 days	Towards operation and maintenance of pollution control system and compliance of consent conditions	30/04/2024	31/08/2024
2	Renewal of Consent	Rs.2/- lakhs	15 days	Installation and commissioning of four ambient air quality monitor stations within area	6 months	31/08/2024

BG Forfeiture History

Srno.	Consent (C2E/C2O/C2R)	Amount of BG imposed	Submission Period	Purpose of BG	Amount of BG Forfeiture	Reason of BG Forfeiture
NA						

BG Return details

Srno.	Consent (C2E/C2O/C2R)	BG imposed	Purpose of BG	Amount of BG Returned
NA				

SCHEDULE-IV
General Conditions:

1. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous waste to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.
2. If the MIDC pipeline is broken/ overflowing chamber, in such cases industry shall not discharge their treated effluent into MIDC drain, it shall be sent to CETP by tanker.
3. Industry should monitor effluent quality, stack emissions and ambient air quality monthly/quarterly.
4. The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.
5. Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipment, the production process connected to it shall be stopped.

06/12/2021

6. The applicant shall provide an alternate electric power source sufficient to operate all pollution control facilities installed to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms and conditions of this consent.
7. The firm shall submit to this office, the 30th day of September every year, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as per the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.
8. The industry shall recycle/reprocess/reuse/recover Hazardous Waste as per the provision contain in the H&OW(M&TM) Rules 2016, which can be recycled/processed/ reused/ recovered and only waste which has to be incinerated shall go to incineration and waste which can be used for land filling and cannot be recycled/ reprocessed etc. should go for that purpose, in order to reduce load on incineration and landfill site/environment.
9. The industry should comply with the Hazardous & Other Wastes (M & TM) Rules, 2016 and submit the Annual Returns as per Rule 6(5) & 20(2) of Hazardous & Other Wastes (M & TM) Rules, 2016 for the preceding year April to March in Form-IV by 30th June of every year.
10. An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.
11. The applicant shall make an application for renewal of the consent at least 60 days before the date of the expiry of the consent.
12. Industry shall strictly comply with the Water (P&CP) Act, 1974, Air (P&CP) Act,1981 and Environmental Protection Act,1986 and industry specific standard under EP Rules 1986 which are available on MPCB website(www.mpcb.gov.in).
13. The industry shall constitute an Environmental cell with qualified staff/personnel/agency to see the day to day compliance of consent condition towards Environment Protection.
14. Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of the collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes/sewers downstream of the terminal manholes. No effluent shall find its way other than in designed and provided collection system.
15. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.
16. The applicant shall install a separate meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.
17. Conditions for D.G. Set
    a) Noise from the D.G. Set should be controlled by providing an acoustic enclosure or by treating the room acoustically.
    b) Industry should provide acoustic enclosure for control of noise. The acoustic enclosure/ acoustic treatment of the room should be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on higher side. A suitable exhaust muffler with insertion loss of 25 dB (A) shall also be provided. The measurement of insertion loss will be done at different points at 0.5 meters from acoustic enclosure/room and then average.
    c) Industry should make efforts to bring down noise level due to DG set, outside industrial premises, within ambient noise requirements by proper sitting and control measures.
    d) Installation of DG Set must be strictly in compliance with recommendations of DG Set manufacturer.
    e) A proper routine and preventive maintenance procedure for DG set should be set and followed in consultation with the DG manufacturer which would help to prevent noise levels of DG set from deteriorating with use.

06/1

f) D.G. Set shall be operated only in case of power failure.

g) The applicant should not cause any nuisance in the surrounding area due to operation of D.G. Set.

h) The applicant shall comply with the notification of MoEFCC, India on Environment (Protection) second Amendment Rules vide GSR 371(E) dated 17.05.2002 and its amendments regarding noise limit for generator sets run with diesel.

18. The industry should not cause any nuisance in surrounding area.
19. The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB (A) during day time and 70 dB (A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.
20. The applicant shall maintain good housekeeping.
21. The applicant shall bring minimum 33% of the available open land under green coverage/ plantation. The applicant shall submit a yearly statement by 30th September every year on available open plot area, number of trees surviving as on 31st March of the year and number of trees planted by September end
22. The non-hazardous solid waste arising in the factory premises, sweepings, etc. be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal of solid waste.
23. The applicant shall not change or alter the quantity, quality, the rate of discharge, temperature or the mode of the effluent/emissions or hazardous wastes or control equipment provided for without previous written permission of the Board. The industry will not carry out any activity, for which this consent has not been granted/without prior consent of the Board.
24. The industry shall ensure that fugitive emissions from the activity are controlled so as to maintain clean and safe environment in and around the factory premises
25. The industry shall submit official e-mail address and any change will be duly informed to the MPCB.
26. The industry shall achieve the National Ambient Air Quality standards prescribed vide Government of India, Notification dtd. 16.11.2009 as amended.

For and on behalf of the
Maharashtra Pollution Control Board.

(Dr.V.M.Motghare)
Joint Director (Air Pollution Control)
06/12/2021

MAHARASHTRA POLLUTION CONTROL BOARD

Tel: 24010706/24010437
Fax: 24044532/4024068/4023516
Website: http://mpcb.gov.in
Email: jdair@mpcb.gov.in

Kalpataru Point, 2nd, 3rd and 4th floor, Opp. Cine Planet Cinema, Near Sion Circle, Sion (E), Mumbai-400022

RED/S.S.I (R35)
No:- Format1.0/APAE Section/UAN No.MPCB-CONSENT-0000205838/CR/2407003055

Date: 31/07/2024

To,
Ashapura Minchem Limited,
Gut No.15-21, 27-31, 34-35, 56-59, 69, 70,74,
Village- Rowale, Tal - Dapoli, Dist - Ratnagiri

Your Service is Our Duty

Sub: Renewal of Consent to Operate

Ref:
1. Consent to Operate granted vide Format1.0/APAE Section/UAN No. 000110617/ CR/CC-397 dated 07/12/2021 valid upto 30/04/2024.
2. Show Cause Notice vide letter dated 19/07/2024.
3. Your reply vide dated 20/07/2024.

Your application No.MPCB-CONSENT-0000205838 Dated 07.04.2024

For: grant of Consent to Operate under Section 26 of the Water (Prevention & Control of Pollution) Act, 1974 & under Section 21 of the Air (Prevention & Control of Pollution) Act, 1981 and Authorization under Rule 6 and Rule 18(7) of the Hazardous & Other Wastes (Management & Transboundary Movement) Rules 2016 is considered and the consent is hereby granted subject to the following terms and conditions and as detailed in the schedule I, II, III & IV annexed to this order:

1. **The consent to renewal is granted for a period up to 30/04/2027**
2. **The capital investment of the project is Rs.5.57 Crs. (As per C.A Certificate submitted by industry)**
3. **Consent is valid for the manufacture of:**

Sr No	Product	Maximum Quantity	UOM
Products			
1	Bauxite Ore	800000	MT/A

(Mining lease area of 218.285 hectares)

4. **Conditions under Water (P&CP), 1974 Act for discharge of effluent:**

Sr No	Description	Permitted (in CMD)	Standards to	Disposal Path
1.	Trade effluent	0	As per Schedule-I	Not Applicable
2.	Domestic effluent	2.4	As per Schedule-I	Soaked in soak pit

5. **Conditions under Air (P& CP) Act, 1981 for air emissions:**

Sr No.	Stack No.	Description of stack / source	Number of Stack	Standards to be achieved
1	0	NA	0	As per Schedule -II

6. **Non-Hazardous Wastes:**

Sr No	Type of Waste	Quantity	UoM	Treatment	Disposal
1	Waste Bauxite Ore Mineral	0.62	MTPA	NA	Sale to authorized party

7. **Conditions under Hazardous & Other Wastes (M & T M) Rules 2016 for Collection, Segregation, Storage, Transportation, Treatment and Disposal of hazardous waste:**

Sr No	Category No./ Type	Quantity	UoM	Treatment	Disposal
NA					

Industry shall not generate any Hazardous Waste.

8. The Board reserves the right to review, amend, suspend, revoke etc. this consent and the same shall be binding on the industry.
9. This consent should not be construed as exemption from obtaining necessary NOC/permission from any other Government authorities
10. The applicant shall comply with the conditions of the Environmental Clearance granted by MoEF, New Delhi vide letter F. No.J-11015/417/2013-IA-II(M) dtd. 24/02/2016
11. PP shall carry out plantation as per EC condition before ensuing monsoon.
12. PP shall provide treatment plant for mine water discharge and submit sedimentation tank design details.
13. PP shall comply with the conditions stipulated in NOC issued by Central Ground Water Authority vide dtd. 08/12/2019 valid upto 07/12/2021 and shall obtain renewal of same time to time.
14. Industry shall extend all existing BGs towards O&M of pollution control systems and towards compliance of the Consent conditions.
15. This consent is granted without prejudice of the order passed or being passed by the Hon'ble National Green Tribunal (WZ) Pune for the case No. 74 of 2024.
16. It is obligatory on the part of the Project proponent to restrict the mining operations above ground water table & it should not intersect ground water table without obtaining prior approval of MoEF & Climate Change, GoI & Central Ground Water Authority for mining below water table.
17. PP shall provide minimum four ambient air quality monitor stations within area within period of Six months which should monitor the parameters such as SPM, RSPM, SO2, NOx, HC, CO etc. to conform to the National Ambient Air Quality Standards prescribed under Air (Prevention and Control of Pollution) Act, 1981 and Environment (Protection) Act, 1986. Bank Guarantee of Rs.2/- lakhs shall be submitted within 15 days towards the compliance of the same.
18. PP shall inform to the Board before starting mining operations and Regional Officer shall ensure the compliances of consent conditions and Pollution Control Systems provided by industry and submit the compliance report.
19. Industry shall comply with Maharashtra Plastic Waste Management & Handling Rules 2018 and Plastic and Thermocol Products (MUSTH&S) Notification, 2018 and amendments issued from time to time.
20. Industry shall comply with E-Waste (Management and Handling) Rule, 2016.

21. The industry shall obtain necessary permission from the Directorate of Industrial Safety and Health (DISH).
22. The applicant shall make an application for renewal of consent 60 days prior to date of expiry of the consent.
23. The industry shall create an Environment Cell by appointing an Environmental Engineer / Expert for looking after day-to-day activities related to Environment / Pollution control.

This consent is issued on the basis of information/documents submitted by the Applicant/Project Proponent, if it has been observed that the information submitted by the Applicant/Project Proponent is false, misleading or fraudulent, the Board reserves its right to revoke the consent & further legal action will be initiated against the Applicant/Project Proponent.

Received Consent fee of -

Sr.No	Amount(Rs.)	Transaction/DR.No.	Date	Transaction Type
1	125000.00	TXN2404001609	09/04/2024	Online Payment
2	960000.00	TXN2406001279	07/06/2024	Online Payment

Balance fees was Rs. 50000/- will be considered in next consent.

Copy to:

1. Regional Officer, MPCB, Kolhapur and Sub-Regional Officer, MPCB, Chiplun

- They are directed to ensure the compliance of the consent conditions.

2. Chief Accounts Officer, MPCB,Sion, Mumbai

SCHEDULE-I

Terms & conditions for compliance of Water Pollution Control:

1. A] Generation - As per your application the treated effluent generation is Nil.
   B] Treatment - NA
   C] Disposal - NA

2. A] As per your application, you have provided Septic Tank followed by Soak pit for the treatment of 2.4 CMD of sewage.

   B] The Applicant shall operate the sewage treatment system to treat the sewage so as to achieve the following standards.

Sr.No	Parameters	Standards (mg/l)	
1	BOD (3 days 27°C)	Not to exceed	100 mg/l
2	Suspended Solids	Not to exceed	100 mg/l.

   C] The treated domestic effluent shall be soaked in a soak pit, which shall be got cleaned periodically. Overflow, if any, shall be used on land for gardening / plantation only.

3. The Board reserves its rights to review plans, specifications or other data relating to plant setup for the treatment of waterworks for the purification there of & the system for the disposal of sewage or trade effluent or in connection with the grant of any consent conditions. The Applicant shall obtain prior consent of the Board to take steps to establish the unit or establish any treatment and disposal system or an extension or addition thereto.

4. The industry shall ensure replacement of pollution control system or its parts after expiry of its expected life as defined by manufacturer so as to ensure the compliance of standards and safety of the operation thereof.

5. The Applicant shall comply with the provisions of the Water (Prevention & Control of Pollution) Act, 1974 and as amended, by installing water meters and other provisions as contained in the said act:

Sr. No.	Purpose for water consumed	Water consumption quantity (CMD)
1.	Industrial Cooling, spraying in mine pits or boiler feed	60.00
2.	Domestic purpose	8.00
3.	Processing whereby water gets polluted & pollutants are easily biodegradable	0.00
4.	Processing whereby water gets polluted & pollutants are not easily biodegradable and are toxic	0.00
5.	Gardening	12

6. The Applicant shall provide Specific Water Pollution control system as per the conditions of EP Act, 1986 and rule made there under from time to time/ Environmental Clearance/ CREP guidelines.

SCHEDULE-II

Terms & conditions for compliance of Air Pollution Control:

1. As per your application, you have provided the Air pollution control (APC) system and erected following stack (s) to observe the following fuel pattern:

Stack No.	Source	APC System provided/proposed	Stack Height(in mtr)	Type of Fuel	Sulphur Content(in %)	Pollutant	Standard
0	NA		0.00	0 0 -- NA--	-	TPM	150 Mg/Nm^3

2. The Applicant shall provide Specific Air Pollution control equipments as per the conditions of EP Act, 1986 and rule made there under from time to time/ Environmental Clearance / CREP guidelines.
3. The Applicant shall obtain necessary prior permission for providing additional control equipment with necessary specifications and operation thereof or alteration or replacement/alteration well before its life come to an end or erection of new pollution control equipment.
4. The Board reserves its rights to vary all or any of the condition in the consent, if due to any technological improvement or otherwise such variation (including the change of any control equipment, other in whole or in part is necessary).
5. Control Equipments
   a. Scientific spraying of water on all working area, dump area, stock piles with the help of appropriate dust suppression system.
   b. Minerals shall be properly covered during transportation.
   c. The applicant shall carry out tree plantation along road side, around dumps or compulsory afforestation as per proposal approved by Forest Department. The tree plantation programme shall be taken up well in advance of the actual mining activity, so that green belt of sufficient width & height is developed between mining area/road and surrounding environment.
   d. Black topped metal roads provided shall be well maintained to prevent dust formation.
   e. Overloading of dumpers shall be avoided to prevent spillages.
   f. Correct type & quantity of explosive shall be used to avoid excess dust formation & vibration in the surrounding area.
   g. The slope of the over burden shall have slope not more than 28^{o} to the horizontal. The overburden shall be properly covered by vegetation for stabilization.
   h. Bauxite Ore / Minerals transportation shall be done by installing conveyors wherever possible & mechanically covered closed trucks shall be used for transportation.
   i. Dust containment-cum-suppression system for the equipment.
6. Standards for Ambient Air Pollutants:

   The Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_x) concentration in downwind direction considering predominant wind direction, at a distance of 500 metres from the following dust generating sources shall not exceed the standards specified in the table given below:

   Dust Generating Sources:

   Loading or unloading, Haul Road, coal transportation road, Coal handling plant (CHP), Railway Sliding, Blasting, Drilling, Overburden dumps, or any other dust generating external sources like coke ovens (hard as well as soft), briquette industry, nearby road etc.

Pollutant	***Time weighted average***	***Concentration in Ambient Air***
Suspended Particulates Matter (SPM)	Annual Average	360 µg/m^3
	24 hours	500 µg/m^3
Respirable Particulate Matter (size less than 10 µm) (RPM)	Annual Average	180 µg/m^3
	24 hours	250 µg/m^3
Sulphur Dioxide (SO_2)	Annual Average	80 µg/m^3
	24 hours	120 µg/m^3
Oxides of Nitrogen as NO_x	Annual Average	80 µg/m^3
	24 hours	120 µg/m^3

i. In case of any residential or commercial or industrial place falls within 500 metres of any dust generating sources, the National Ambient Air Quality Standards notified vide MOEFCC GOI notification dtd 16.11.2009 as ammended shall be made applicable.

ii. The applicant shall provide minimum three ambient air quality monitoring stations within mining area which should be monitored for SPM, RSPM, SO_2, NOx, HC, CO etc. The Annual Arithmetic Mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval shall conform to the National Ambient Air Quality Standards prescribed under Air (Prevention and Control of Pollution) Act, 1981 and Environment (Protection) Act, 1986. The records of results of monitoring done shall be made available for inspection to the officers of the Board.

7. The applicant shall take adequate measures for control of noise levels from its own sources as follows:

Sr. No	***Location***	***Permissible Norms [in dB (A)]***	***Desired minimum thickness of green belt (m)***
1.	Along Road side	65 (Commercial Area)	20
2.	In colonies	55 (Residential Area)	20
3.	Near Opencast Mines	75 (Industrial Area)	10
4.	Near CHPs	75	30
5.	Near Shaft	75	20
6.	Near Mine exhaust fan	75	> 50

8. Other conditions:

i Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess standards laid down, such information shall be forthwith reported to Board, concerned Police station, office of Directorate of Health services, Dept. of explosives, Inspectorate of Factories & Local Body. In case of failure of pollution control equipments, the production process connected to it shall be stopped.

SCHEDULE-III

Details of Bank Guarantees:

Sr. No.	Consent (C2E/ C2O /C2R)	Amt of BG Imposed	Submission Period	Purpose of BG	Compliance Period	Validity Date
1	C2R	Rs.5.0/- lakh	Existing	Towards operation and maintenance of pollution control system and compliance of consent conditions	30/04/2027	30/04/2028
2	C2R	Rs.2.0/- lakh	Existing	Operation of four ambient air quality monitor stations within area	30/04/2027	30/04/2028

****Existing BG obtained for above purpose if any, may be extended for period of validity as above.**

If the above Bank Guarantee is not submitted within stipulated period, then 12% interest will be levied as a penalty as per circular dtd 29/02/2024 No. BO/MPCB/AS(T)/Circular/B-240229FTS0122

BG Forfeiture History

Srno.	Consent (C2E/C2O/C2R)	Amount of BG imposed	Submission Period	Purpose of BG	Amount of BG Forfeiture	Reason of BG Forfeiture
NA						

BG Return details

Srno.	Consent (C2E/C2O/C2R)	BG imposed	Purpose of BG	Amount of BG Returned
NA				

SCHEDULE-IV

General Conditions:

1. The applicant shall provide facility for collection of environmental samples and samples of trade and sewage effluents, air emissions and hazardous waste to the Board staff at the terminal or designated points and shall pay to the Board for the services rendered in this behalf.
2. If the MIDC pipeline is broken/ overflowing chamber, in such cases industry shall not discharge their treated effluent into MIDC drain, it shall be sent to CETP by tanker.
3. Industry should monitor effluent quality, stack emissions and ambient air quality monthly/quarterly.
4. The applicant shall provide ports in the chimney/(s) and facilities such as ladder, platform etc. for monitoring the air emissions and the same shall be open for inspection to/and for use of the Board's Staff. The chimney(s) vents attached to various sources of emission shall be designated by numbers such as S-1, S-2, etc. and these shall be painted/ displayed to facilitate identification.
5. Whenever due to any accident or other unforeseen act or even, such emissions occur or is apprehended to occur in excess of standards laid down, such information shall be forthwith Reported to Board, concerned Police Station, office of Directorate of Health Services, Department of Explosives, Inspectorate of Factories and Local Body. In case of failure of pollution control equipment, the production process connected to it shall be stopped.
6. The applicant shall provide an alternate electric power source sufficient to operate all pollution control facilities installed to maintain compliance with the terms and conditions of the consent. In the absence, the applicant shall stop, reduce or otherwise, control production to abide by terms and conditions of this consent.
7. The firm shall submit to this office, the 30th day of September every year, the Environmental Statement Report for the financial year ending 31st March in the prescribed Form-V as per the provisions of rule 14 of the Environment (Protection) (Second Amendment) Rules, 1992.
8. The industry shall recycle/reprocess/reuse/recover Hazardous Waste as per the provision contain in the H&OW(M&TM) Rules 2016, which can be recycled/processed/ reused/ recovered and only waste which has to be incinerated shall go to incineration and waste which can be used for land filling and cannot be recycled/ reprocessed etc. should go for that purpose, in order to reduce load on incineration and landfill site/environment.
9. The industry should comply with the Hazardous & Other Wastes (M & TM) Rules, 2016 and submit the Annual Returns as per Rule 6(5) & 20(2) of Hazardous & Other Wastes (M & TM) Rules, 2016 for the preceding year April to March in Form-IV by 30th June of every year.
10. An inspection book shall be opened and made available to the Board's officers during their visit to the applicant.
11. The applicant shall make an application for renewal of the consent at least 60 days before the date of the expiry of the consent.
12. Industry shall strictly comply with the Water (P&CP) Act, 1974, Air (P&CP) Act,1981 and Environmental Protection Act,1986 and industry specific standard under EP Rules 1986 which are available on MPCB website(www.mpcb.gov.in).
13. The industry shall constitute an Environmental cell with qualified staff/personnel/agency to see the day to day compliance of consent condition towards Environment Protection.

14. Separate drainage system shall be provided for collection of trade and sewage effluents. Terminal manholes shall be provided at the end of the collection system with arrangement for measuring the flow. No effluent shall be admitted in the pipes/sewers downstream of the terminal manholes. No effluent shall find its way other than in designed and provided collection system.
15. Neither storm water nor discharge from other premises shall be allowed to mix with the effluents from the factory.
16. The applicant shall install a separate meter showing the consumption of energy for operation of domestic and industrial effluent treatment plants and air pollution control system. A register showing consumption of chemicals used for treatment shall be maintained.
17. Conditions for D.G. Set
    a) Noise from the D.G. Set should be controlled by providing an acoustic enclosure or by treating the room acoustically.
    b) Industry should provide acoustic enclosure for control of noise. The acoustic enclosure/ acoustic treatment of the room should be designed for minimum 25 dB (A) insertion loss or for meeting the ambient noise standards, whichever is on higher side. A suitable exhaust muffler with insertion loss of 25 dB (A) shall also be provided. The measurement of insertion loss will be done at different points at 0.5 meters from acoustic enclosure/room and then average.
    c) Industry should make efforts to bring down noise level due to DG set, outside industrial premises, within ambient noise requirements by proper sitting and control measures.
    d) Installation of DG Set must be strictly in compliance with recommendations of DG Set manufacturer.
    e) A proper routine and preventive maintenance procedure for DG set should be set and followed in consultation with the DG manufacturer which would help to prevent noise levels of DG set from deteriorating with use.
    f) D.G. Set shall be operated only in case of power failure.
    g) The applicant should not cause any nuisance in the surrounding area due to operation of D.G. Set.
    h) The applicant shall comply with the notification of MoEFCC, India on Environment (Protection) second Amendment Rules vide GSR 371(E) dated 17.05.2002 and its amendments regarding noise limit for generator sets run with diesel.
18. The industry should not cause any nuisance in surrounding area.
19. The industry shall take adequate measures for control of noise levels from its own sources within the premises so as to maintain ambient air quality standard in respect of noise to less than 75 dB (A) during day time and 70 dB (A) during night time. Day time is reckoned in between 6 a.m. and 10 p.m. and night time is reckoned between 10 p.m. and 6 a.m.
20. The applicant shall maintain good housekeeping.
21. The applicant shall bring minimum 33% of the available open land under green coverage/ plantation. The applicant shall submit a yearly statement by 30th September every year on available open plot area, number of trees surviving as on 31st March of the year and number of trees planted by September end
22. The non-hazardous solid waste arising in the factory premises, sweepings, etc. be disposed of scientifically so as not to cause any nuisance / pollution. The applicant shall take necessary permissions from civic authorities for disposal of solid waste.
23. The applicant shall not change or alter the quantity, quality, the rate of discharge, temperature or the mode of the effluent/emissions or hazardous wastes or control equipment provided for without previous written permission of the Board. The industry will not carry out any activity, for which this consent has not been granted/without prior consent of the Board.

24. The industry shall ensure that fugitive emissions from the activity are controlled so as to maintain clean and safe environment in and around the factory premises
25. The industry shall submit official e-mail address and any change will be duly informed to the MPCB.
26. The industry shall achieve the National Ambient Air Quality standards prescribed vide Government of India, Notification dtd. 16.11.2009 as amended.

This certificate is digitally & electronically signed.

ANNEXURE-R-13

BEFORE THE NATIONAL GREEN TRIBUNAL, WESTERN ZONE BENCH, PUNE

Application No.74/2016 (WZ)

In the matter of:-

Vivek Pandit V/s The State of Maharashtra

CORAM: HON'BLE MR. JUSTICE U. D. SALVI, JUDICIAL MEMBER
HON'BLE DR. NAGIN NANDA, EXPERT MEMBER

Present: **Applicant/Appellant : Absent.**
Respondent No.4 : Mrs. Manasi Joshi, Adv.
Respondent No.5 : Mr. Punit Tyagi, Adv. a/w
Mr. Monish S. Nilwant, Adv.

Date and Remarks	Orders of the Tribunal
Item No.12 **20th July, 2017** **Order No.10**	Nobody appears on behalf the Applicant though the matter has been kept for hearing on several occasions and lastly has been kept for dismissal. The record reveals that activity in question have environmental clearances as well as consents to operate granted by the Authorities. The record further reveals that there has been no instance of ill health of severe nature as narrated by the Applicant vide affidavit dated 16th September, 2016 of the District Mining Officer (page 250 to 260). The affidavit in reply of the Respondent No.4 dated 5th August, 2016 reveals the present status of the Respondent No.5 – M/s. Ashapura Minichem Ltd. as under: "**17. Present status of Resp No.5 i.e. M/s Ashapura Mine Chem Ltd., Umbershet, Bauxite Mine, Tal Dapoli, Dist – Ratnagiri:-** The Sub Regional Officer, Chiplun has caused visit on 11.7.2016 and reported that at present the Respondent No.5 is not in operation due to monsoon. The Respondent No.5 has provided provision of mobile water tankers for sprinkling on haul roads, internal roads and transportation roads as well as provided permanent water sprinkling arrangement near weigh bridge and metallic roads within the premises. The Respondent No.5 is using tarpaulin covered trucks for transportation of bauxite ore and installed 4 Ambient Air Quality Monitoring stations within the premises. The Industry is monitoring AAQM in buffer and core zone through an approved laboratory of Ministry of Environment and Forest, Govt. of India. It has been also reported the industry has provided garland drains,

Item No.12 **20th July, 2017** **Order No.10**	trenches and bunds around the stock and provided siltation pond and catch drains in low lying area for rain water harvesting. The Industry has planted appx 1500 trees in back filled area in the last year and also planted approx. 6300 no of plants in lease area. A copy of Sub Regional Officer, Chiplun dated 3/8/2016 is enclosed alongwith the visit report dated 11.7.2016 are enclosed and marked as an **Annexure "XVI".** Perhaps for this reason the Applicant has chosen to remain away from the Bench. Hence dismissed. **Application No.74/2016 stands disposed of accordingly.** ....., **JM** **(Justice U. D. Salvi)** ....., **EM** **(Dr. Nagin Nanda)**

mk

NATIONAL GREEN TRIBUNAL, NEW DELHI

TRUE COPY ADVOCATE

ANNEXURE-R-14

MEMBER SECRETARY

केन्द्रीय भूमि जल प्राधिकरण
जल संसाधन, नदी विकास एवं
गंगा संरक्षण मंत्रालय
भारत सरकार

Central Ground Water Authority
Ministry of Water Resources
River Development & Ganga Rejuvenation
Government of India

File No: - 21-4/731/MH/MIN/2017 - 2048

NOC No: - CGWA/NOC/MIN/ORIG/2017/2893

Date:- 18 DEC 2017

To

M/s Ashapura Minechem Ltd,
Velas Sakhri Sakhri Umbershet Rowale Kavdoli
And Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt
278, Jeevan Udyog Building, 3rd Floor D. N. Road,
Fort, Taluka & District Mumbai, Maharashtra – 400001

Sub: - NOC for ground water withdrawal to M/s Ashapura Minechem Ltd, Velas Sakhri Sakhri Umbershet Rowale Kavdoli And Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt in respect of their existing Mineral Products project located at Village Umbershet, Taluka Dapoli, District Ratnagiri, Maharashtra – reg.

Refer to your application on the above cited subject. Based on recommendations of Regional Director, Central Ground Water Board, Central Region, Nagpur vide their recommendations dated 14/08/2017 with clarification dated 30/03/2017 and further deliberations on the subject, the NOC of Central Ground Water Authority is hereby accorded to **M/s Ashapura Minechem Ltd, Velas Sakhri Sakhri Umbershet Rowale Kavdoli And Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt in respect of their existing Mineral Products project located at Village Umbershet, Taluka Dapoli, District Ratnagiri, Maharashtra.** The NOC is, however subject to thefollowing conditions:-

1. The firm may abstract **280 cu.m/day** for 240 days (not exceeding **67,200 cu.m/year**) of ground water through proposed one (1) dug well only. No additional dewatering and no additional ground water abstraction structures to be constructed for this purpose without prior approval of the CGWA.
2. The dug well shall be fitted with water meter by the firm at its own cost and monitoring of ground water abstraction shall be under taken accordingly on regular basis, at least once in a month.
3. **M/s Ashapura Minechem Ltd, Velas Sakhri Sakhri Umbershet Rowale Kavdoli And Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt**, may implement ground water recharge measures in consultation with the Regional Director, Central Ground Water Board, Central Region, Nagpur to the tune of **93,600 cu.m/year** as proposed, for augmenting the ground water resources of the area. Firm shall report compliance within one year from the date of issue of this letter. Firm shall also undertake periodic maintenance of recharge structures at its own cost.
4. The photographs of the recharge structures after completion of the same are to be furnished immediately to the Regional Director, Central Ground Water Board, Central Region, Nagpur for verification and under intimation to this office.

5. The firm at its own cost shall install one (1) piezometer fitted with digital water level recorder at suitable location and execute monthly ground water regime monitoring in and around the project area on regular basis in consultation with the Central Ground Water Board, Central Region, Nagpur.
6. The ground water quality shall be monitored twice in a year during pre- monsoon and post- monsoon periods.
7. The ground water monitoring data in respect of S. No. 2, 5 & 6 shall be submitted to Central Ground Water Board, Central Region, Nagpur on regular basis at least once in a year.
8. The firm shall ensure proper recycling and reuse of waste water after adequate treatment.
9. Action taken report in respect of S. No. 1 to 8 shall be submitted to CGWA within one year period.
10. The permission is liable to be cancelled in case of non-compliance of any of the conditions as mentioned in S. No. 1 to 9.
11. This NOC is subject to prevailing Central/State Government rules/laws or Court orders related to construction of tubewell/ ground water withdrawal/ construction of recharge or conservation structures/ discharge of effluents or any such matter as applicable.
12. The firm shall report self compliance online in the website (www.cgwa-noc.gov.in) within one year from the date of issue of this NOC.
13. This NOC does not absolve the applicant / proponent of his obligation / requirement to obtain other statutory and administrative clearances from other statutory and administrative authorities.
14. The NOC does not imply that other statutory / administrative clearances shall be granted to the project by the concerned authorities. Such authorities would consider the project on merits and be taking decisions independently of the NOC.
15. This NOC is valid from 08/12/2017 till 07/12/2019.

Member Secretary

Copy to:

1. The Regional Officer, Maharashtra Pollution Control Board, Jog Centre, 3rd Floor, Mumbai-Pune Road, Wakdewadi, Pune, Maharashtra-411003 **with a request to ensure that the conditions mentioned in the NOC are complied by the firm in consultation with the District Collector & Magistrate, District Ratnagiri, Maharashtra.**
2. The District Collector and District Magistrate, District Ratnagiri, Maharashtra for necessary action.
3. The Regional Director, Central Ground Water Board, Central Region, Nagpur. This has reference to your recommendation dated 14/08/2017 with clarification dated 30/03/2017.
4. TS to the Chairman, Central Ground Water Authority, Shram Shakti Bhawan, Rafi Marg, New Delhi.
5. Guard File 2017-18.

Member Secretary

COMPREHENSIVE HYDROGEOLOGICAL REPORT AS PER CGWA GUIDELINES FOR M/S. ASHAPURA MINECHEM LIMITED, VILLAGE UMBERSHET, POST KELSHI, TALUKA DAPOLI, DISTRICT RATNAGIRI, MAHARASHTRA, INDIA.

APPLICANT

M/S. VELAS SAKHRI SAKHRI UMBERSHET ROWALE KAVDOLI AND UTTAMBER BAUXITE MINE, DHANWATE JETTY CONVEYOR BELT, VILLAGE UMBERSHET, POST KELSHI, TALUKA DAPOLI, DISTRICT RATNAGIRI, MAHARASHTRA, INDIA.

REPORT PREPARED BY

M K ASSOCIATES

ACCREDIATED GROUNDWATER CONSULTANT FROM NABET

CERTIFICATE NO. NABET/GWCO/IA/GW023

ADDRESS: 1413/B-1, GUPTESHWAR ROAD, MADAN MAHAL, JABALPUR MP.

MAY-2024

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COMPREHENSIVE HYDROGEOLOGICAL REPORT
ASHAPURA MINECHEM LIMITED

1.0 SALIENT FEATURES OF THE PROPOSAL

1	Application No.	21-4/731/MH/MIN/2017
2	Submission Date	18.01.2024
3	Fresh or Renewal	Renewal 1st
4	Existing or New /Proposed	Existing
5	If Renewal, date of validity of existing/ last NOC	07.12.2023
6	CTO issued date	22.09.2023
7	Name of Project with Address	Velas Sakhri Sakhri Umbershet Rowale Kavdoli and Uttamber Bauxite Mine, Dhanwate Jetty Conveyor Belt, Village Umbershet, Post Kelshi, Taluka Dapoli, District Ratnagiri, Maharashtra.
8	State	Maharashtra
9	District	Ratnagiri
10	Block/ Taluka	Dapoli
11	Category of Block/ Taluka (as per prevailing GWRE)	Safe
12	Quantum of GW applied (KLD)	**95 KLD**
13	Quantum of GW applied (m^3/Year)	**28500 m^3/year.**
14	Alluvium/ non-alluvium	Non-alluvium
15	GW Modelling Required (Yes/ No)	No
16	Name of Authorized Signatory of Project & Designation	Mr. Hemul Shah, Director.
17	Consultant Details with Name of Authorized Signatory (If Institution)	**M K Associates** **Manish Khatri** Accredited by Quality Council of India – NABET Certificate No. NABET/GWCO/IA GW23 **Annexure-1** **Work Order: Annexure-2**
18	In case report is prepared jointly by accredited institute and individual consultant, name details of chapters prepared by the individual consultant	NA
19	Accreditation Certificate No. and Date/ Validity (In case jointly as per Point No. 14, No. and validity of both institution and individual are to be given	NA

Signature with Name

2.0 ABOUT THE PROJECT

M/s Ashapura Minechem Limited (AML) are operating open cast Bauxite Mines with the name of project: **Velas Sakhri Umbershet Rowale Kavdoli and Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt in village Umbershet, Post Kelshi, Taluka Dapoli, District Ratnagiri, Maharashtra**. This area is prominent for Bauxite mining and leases are existing in the region. The project proponent is taking all safe guard to protect environment in and around the mines.

NOC was granted by Central Ground Water Authority, Ministry of Water Resources, Government of India, New Delhi vide NOC No CGWA/NOC/MIN/REN/2/2022/7161 valid from dt 08/12/2021 to 07/12/2023 for withdrawal of ground water 120 m^3/day (28800.00 m^3/Year). The copy of NOC is enclosed in **Annexure-3.**

In Ashapura Minechem Ltd. have two working mine *viz*: Rowale and Umbershet Bauxite Mine. An open cast mining operation opted in respect of Rowale Bauxite ore mine over an area of 218.285 Ha. And Umbershet Bauxite ore mine over an area of 99.861 Ha. Thus, the total active mines lease area of 318.146 ha in villages Rovale & Umbershet, tehsil Dapoli, district Ratnagiri, Maharashtra.

Since the maximum annual production is 5 lakh tonne per annum, the fully mechanized mining method will be followed during the present scheme period (i.e. 2020-21 to 2024-25).

A brief description of project is as below.

Table-1: Salient Features of the Project

S. No.	Particulars	Details
A.	**Name of project and Location**	Velas Sakhri Sakhri Umbershet Rowale Kavdoli and Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt, Village Umbershet, Post Kelshi, Taluka Dapoli, District Ratnagiri, MH.
B.	**Size of project**	
1	Mining Lease area	1. Rowale Bauxite Mine: 218.285 Ha 2. Umbershet Bauxite Mine: 99.861 Ha
2	Lease area coordinates	**Lease Details-** **Rowale Bauxite Mine (218.285 Ha)** belongs to Private land. Latitude : 17.912912° to 17.908470° Longitude: 73.100859° to 73.105552° **Umbershet Bauxite Mine (99.861 Ha)** belongs to Revenue waste land. Latitude : 17.920943° to 17.919694° Longitude: 73.085073° to 73.090513°
3	Bauxite Ore Production capacity	500000 TPA
C.	**Project Location**	
1	Villages	Rowale & Umbershet

2	Tehsil	Dapoli
3	District	Ratnairi
4	State	Maharashtra
5	Study area falls in SOI Toposheet No.	47 G/01
D.	**Environmental Settings Details of the Area (with approx. aerial distance from the mining lease boundary)**	
1	Nearest Town	Kelshi ~ 4 km
2	Villages within 10 km radius.	Umershet, Rowale, Kelshi, Velas, Devhare, Dehen, Panchpandri etc.
3	Nearest Railway Station	Khed ~ 55 km
4	Ecological Sensitive Areas within 10 Km radius in study area	No ecological sensitive area within 10 km radius. Reserved Forest area located at 10.5 km at south
5	Water Bodies and Sea within 10 km radius from the project	Savitri River-10 km in North, Bharja River~3.5 Km towards North, Utamber Khadi~ 2 km towards South, and Arabian Sea – 5.3 km West

Source: Field survey and data provided by PP.

The present report is dealing with qualitative and quantitative assessment of ground water condition in a combined way surrounding of villages of lease area. In this connection, field study was conducted during 9.4.2024 to 11.04.2024. For the detail hydrogeological investigation and to assess hydraulic properties and its characteristics, evaluation of ground water resource and assessment of quality of ground water, an area of 314 sq km has been chosen as circular area of 10 km radius from the center point of the lease/project area.

2.1 Location and Accessibility

Ashapura Minechem Ltd Bauxite Ore Mine located near Umbershet and Rowale villages of Block Dapoli in District Ratnagiri, MH, The mine site falls in Survey of India Toposheet No–47G/01. The location of the project area is shown in ***Figure-1***. Core zone of 2 km and buffer zone of 10 km radius marked on SOI Toposheet Number 47G/01 presented in ***Figure-2.*** Base map of the study area presented in ***Figure-3.*** The core zone and buffer zone for study is considered in the radius of 2 and 10 km respectively.

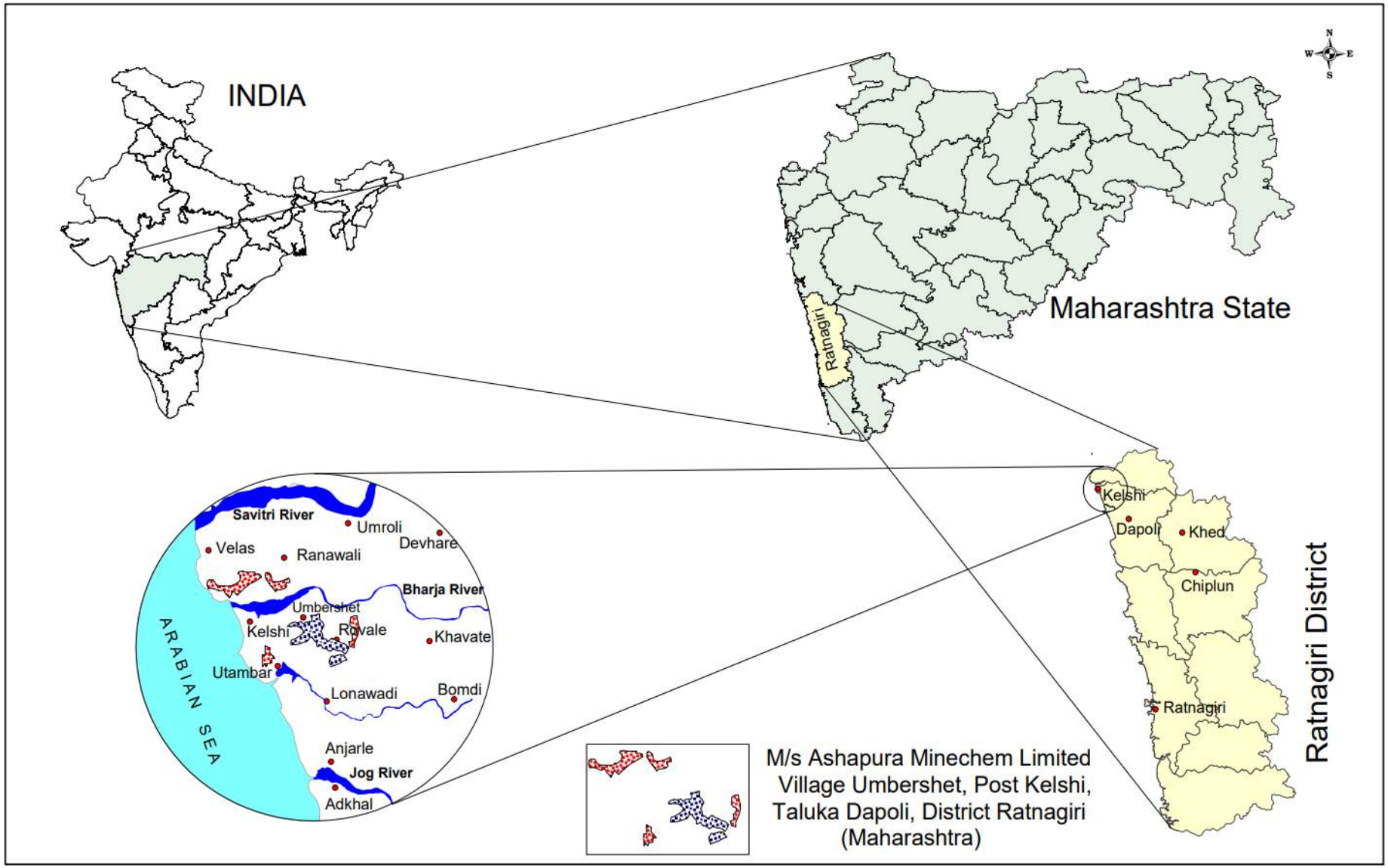


Figure-1: Location of the project area

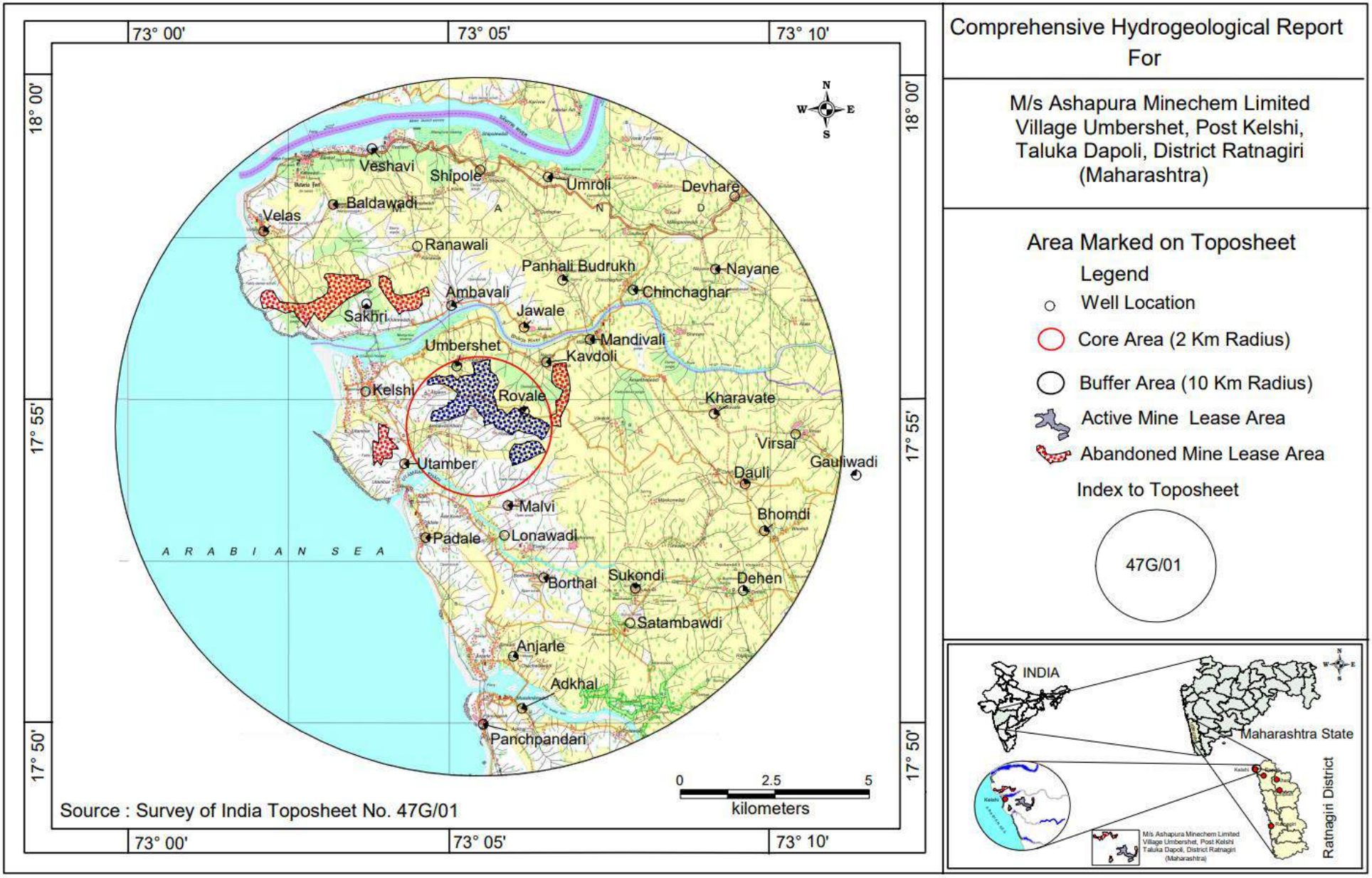


Figure-2: Area marked on Toposheet of Study area

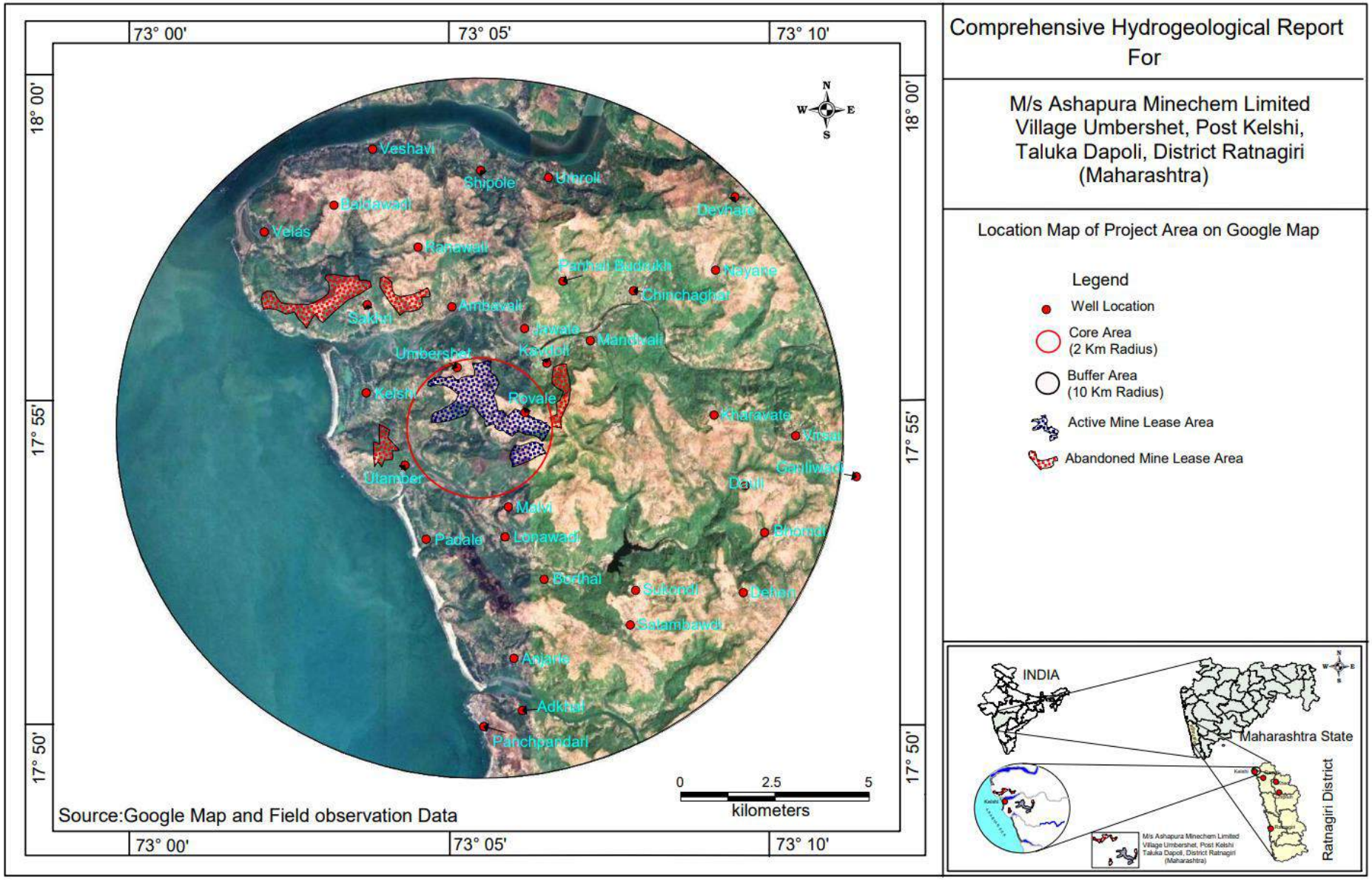


Figure-3: Base map of study area on Google Earth

2.2 Land use / Land cover of the surrounding area

The land use in the village reflects the socio-economic conditions of the people in addition to the natural environmental factors. The land use is also one of the prime parameters to be considered for the ground water estimation. Primarily, 10 Km radius from the Mine site forms part of sea (about 28.5 %). The second major land use is Plantation, which covers 28.4%.

Buffer Zone: The majority of Buffer zone of 10 Km radius from mines boundary occupies Plantation land followed by sea.

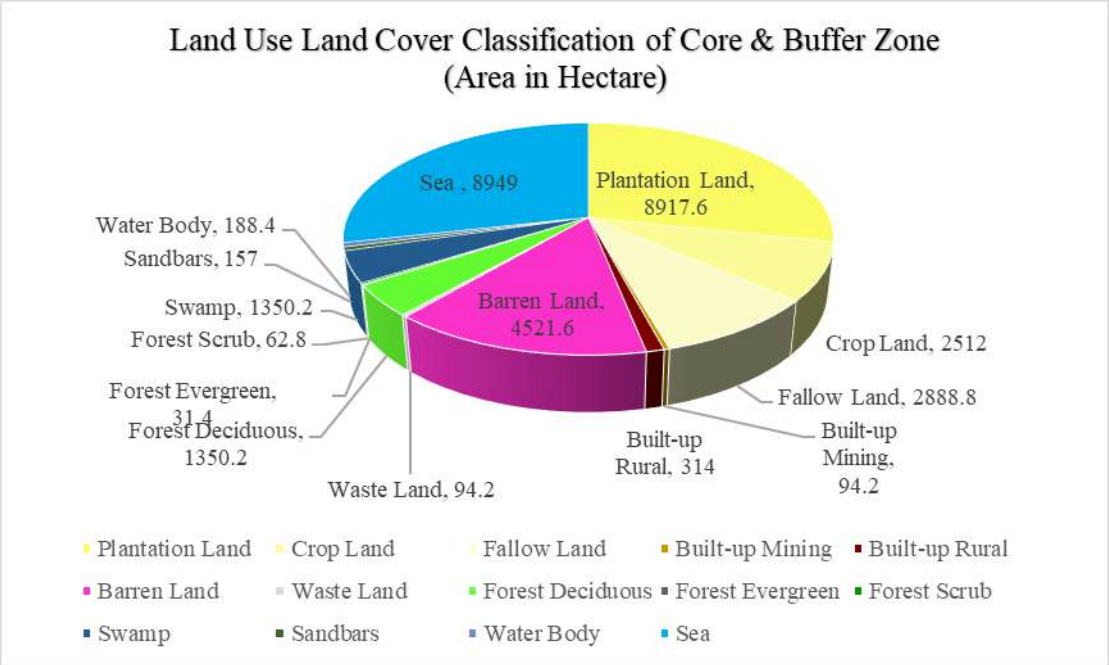
Core Zone: Majority of core zone of 2 Km radius from mines boundary belongs to Plantation land fallowed by Barren land.

Land use and land cover classification in the buffer zone of 10 km radius is given below in **Table-2**, The Land use map is shown in ***Figure-4.***

Table- 2: Details of Land use Land Cover in Buffer Zone

S. No	Description	Area (ha)	Percentage
1	Plantation Land	8917.6	28.4
2	Crop Land	2512	8
3	Fallow Land	2888.8	9.2
4	Built-up Mining	94.2	0.3
5	Built-up Rural	314	1
6	Barren Land	4521.6	14.4
7	Waste Land	94.2	0.3
8	Forest Deciduous	1350.2	4.3
9	Forest Evergreen	31.4	0.1
10	Forest Scrub	62.8	0.2
11	Swamp	1350.2	4.3
12	Sandbars	157	0.5
13	Water Body	188.4	0.6
14	Sea	8949	28.5
	Total	**31400**	**100**

Land use pattern in study area is graphically represented as below:



Pie Chart Showing Land use / Land cover Classification of the Study area

2.3 DEM / Topography

The terrain elevation (Topography) is derived from the NRSA data. The Ground Surface Elevation Map is presented in ***Figure-5.*** The study area (10 km radius from the lease boundary) elevation ranges from 350 m in southeastern, north central and east central part to 01 m in western part of study area. The north central, southeastern, east-central and eastern of the study area comprising hilly terrain with several ridges and plateaus have elevation in range of 350 to 50 m amsl. The west, southwest-central & northeast part are the level plain with gentle undulating terrain have elevation in range of 50 to 01 m amsl.

2 Km Core zone elevation: The elevation of the core zone ranges between 250 and 50 m amsl. The maximum elevation is noticed in the eastern side of the core zone. The core zone is sloping towards west.

The lease area is a part of hilly topography. In Rowale Bauxite Mine, the highest elevation is of 250 m amsl in the eastern part of the hillock and lowest one is of 218 m amsl, while in Umbershet Bauxite Mine the highest elevation is of 221 m amsl in the NE part of the hillock and the lowest one is of 185 m amsl.

2.4 Geomorphology, Drainage

Geomorphology: The land forms / geomorphic units and structures occurring in the study area are mapped. The geomorphology and structures of the area plays the vital role in identifying the ground water potential zones. The outstanding feature in the relief of the study area is its highly uneven nature and very narrow riverine plains that fringe the coastline. About 45 % of the study area is hilly. On the east and southeast this consists of the steep and forbidding scarp of the main Sahyadris. In the center are traverses chains of small and elevated hills, which project from the main ranges, develop higher elevation in the middle portion. These are separated from each other by undulating plateaus having area gradually increasing westward towards the coast. Geomorphologically, the study area has been divided into following two units:

1. Structural Hill
2. Pediment and Denudational Hill

The Main hydro geomorphic units are described as below.

1. Structural Hill: These are the most predominant unit widely distributed in southeastern, Northeastern and north-central part of the study area. This geomorphic unit comprises of lateritic plateau that occupies most of the study area are either formed in-situ from the lateritisation of Deccan Trap Basalt or are of secondary nature, formed due to the lateritic material brought down from the Sahyadrian hill ranges. They are broad, compact and undulating. These are structurally controlled plains with numerous joints/fractures facilitating infiltration and mostly act as run-off zone and rate of infiltration is poor. Ground water potential is poor to moderate. The occurrence and movement of ground water is controlled by the secondary porosity.

2. Pediments: Pediment are found in south-central, southeastern and eastern part of the study area. This is traversed by numerous fractures and joints especially in the basaltic terrain. Groundwater potential is poor to moderate and this unit is suitable for dug wells. **Denudation hills** occur in sporadic distribution in west-middle and southern part of the study area. It is represented by a small hillock. These have either no structural control or structures are obliterated by denudation.

Alluvium occurring along in river banks and valley, usually of mixed origin and are yellowish red to brown in colour. They are light, easily workable, well drained and fairly fertile. Coastal alluvial soil are found along the coastal strip and consist of deep sandy loams.

The mining lease area lies on the pediment, which is gradually sloping towards northwest in Umbershet Bauxite Mine while, slope towards southwest in Rowale Mine. The geomorphological map of the study area is given in ***Figure-6***.

Drainage

The drainage map of the area is shown in ***Figure- 7***. Savitri River, Jog River and Bharja River are westerly flowing rivers and debauching into the Arabian Sea. Savitri River lies in northern part of buffer zone with the flow direction towards west. Bharja River in the north center part and Jog River in southern part of buffer zone. River system is young and due to heavy rainfall, they have tremendous headward erosion. River Savitri and its tributaries crisscross the land, draining into the Arabian Sea at near Veshavi. There is another drainage basin developing in southern part of the study area which forms the catchment area of Jog River, taking a westerly course. Jog River is joined by many first and second order streams originated from south and southeastern part of the study area. The rivers and nalas show high meandering features as the area has been suffered prolonged weathering. The drainage pattern in the study area is dendritic to sub dendritic. Beside these rivers, Utamber creek is originated from southeastern upper plateau at an altitude of about 250 m amsl. Utamber creek is about 3.2 km long and flows west into the Arabian sea.

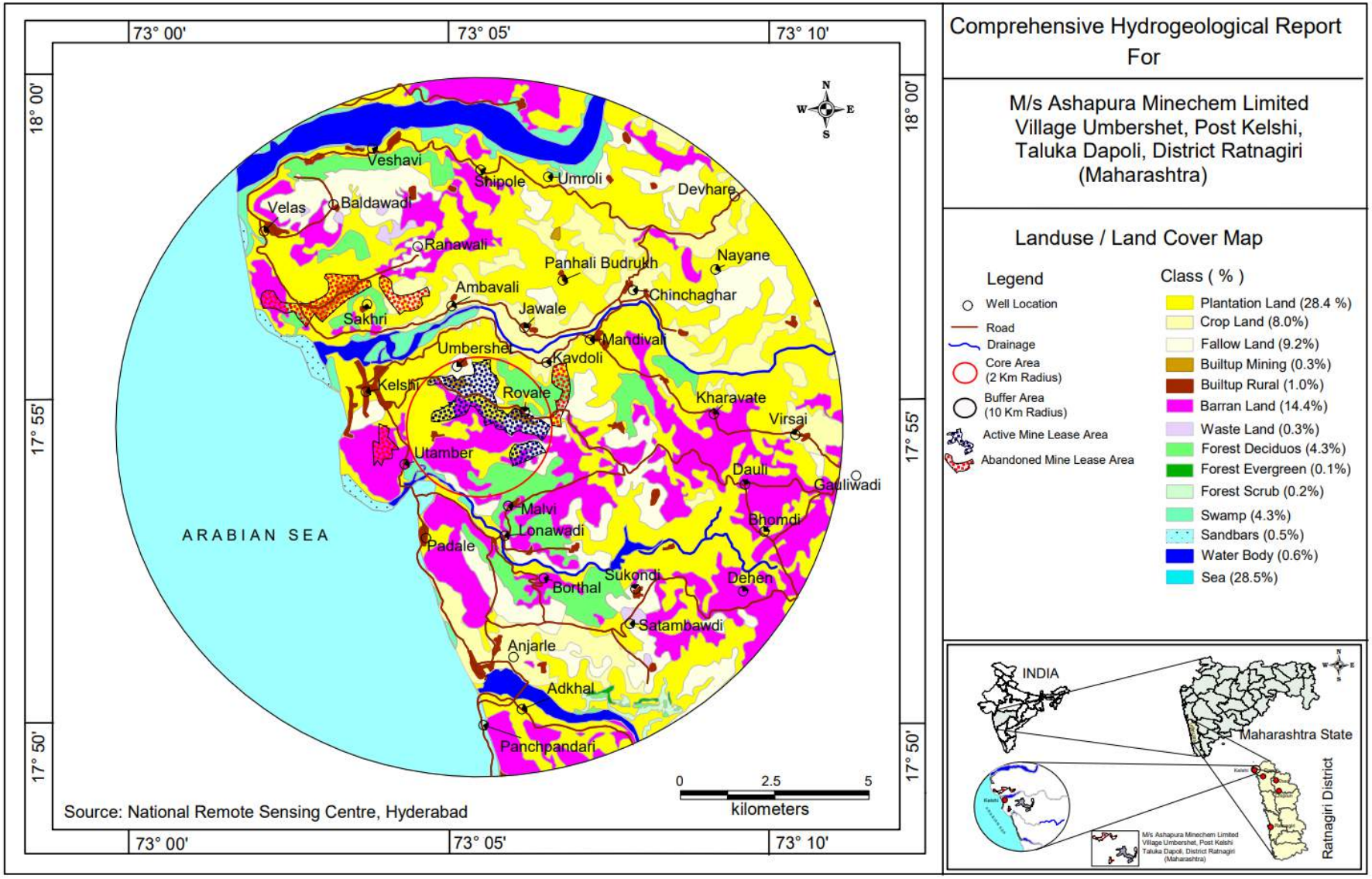


Figure-4: Land use and land Cover Map of Study are

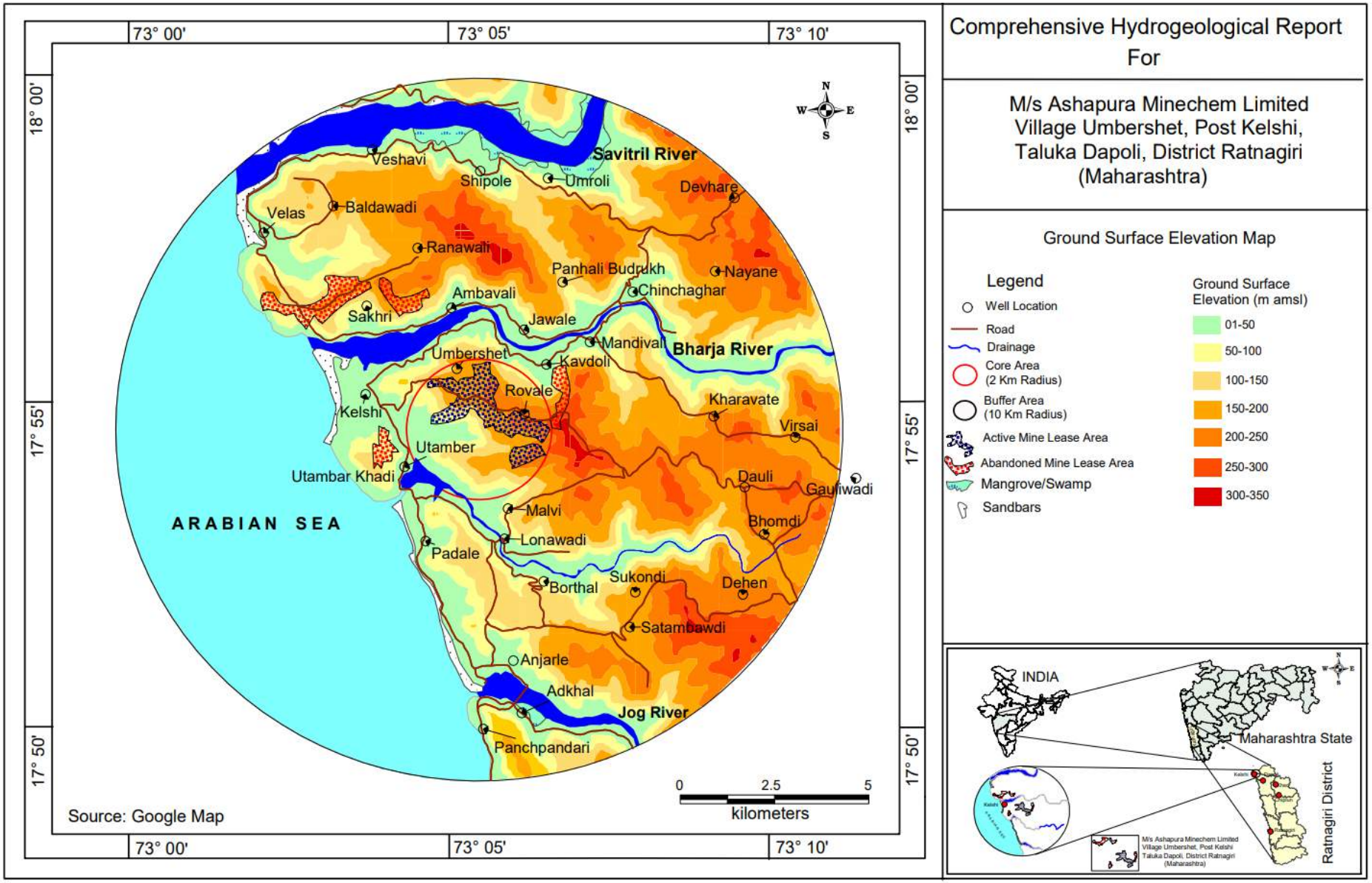


Figure-5: Ground Surface Elevation map of Study area

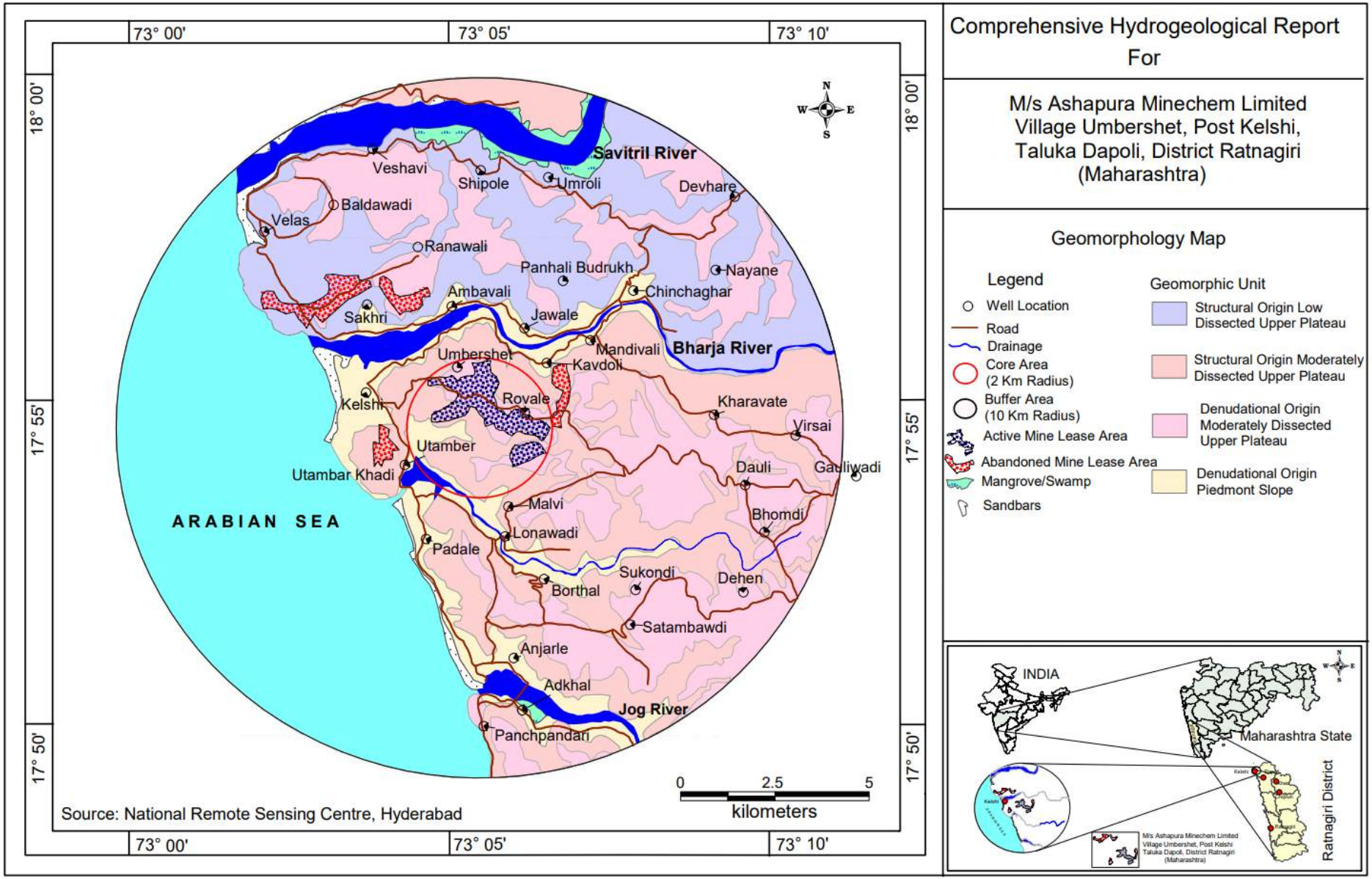


Figure -6: Geomorphology map of Study area

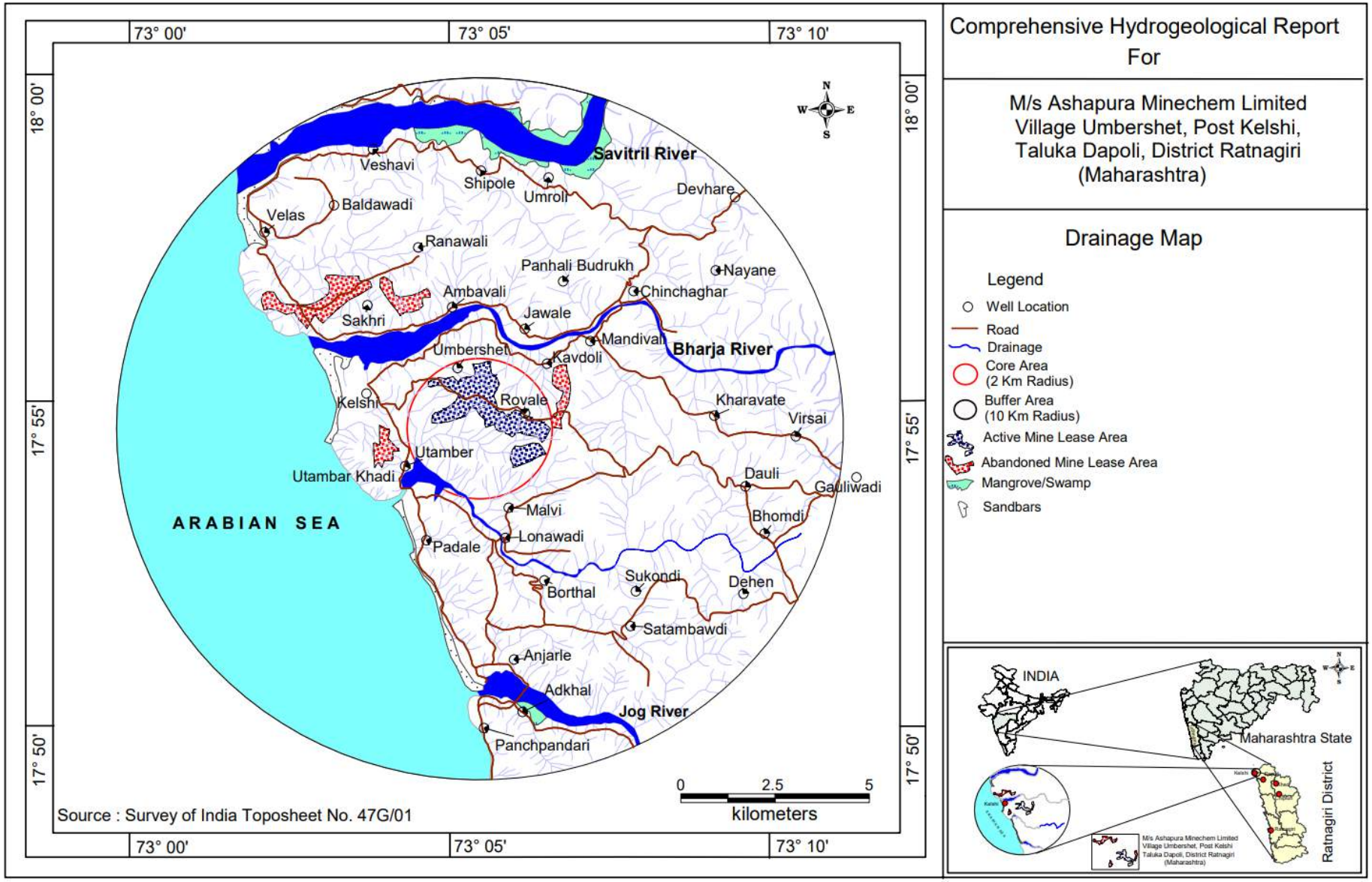
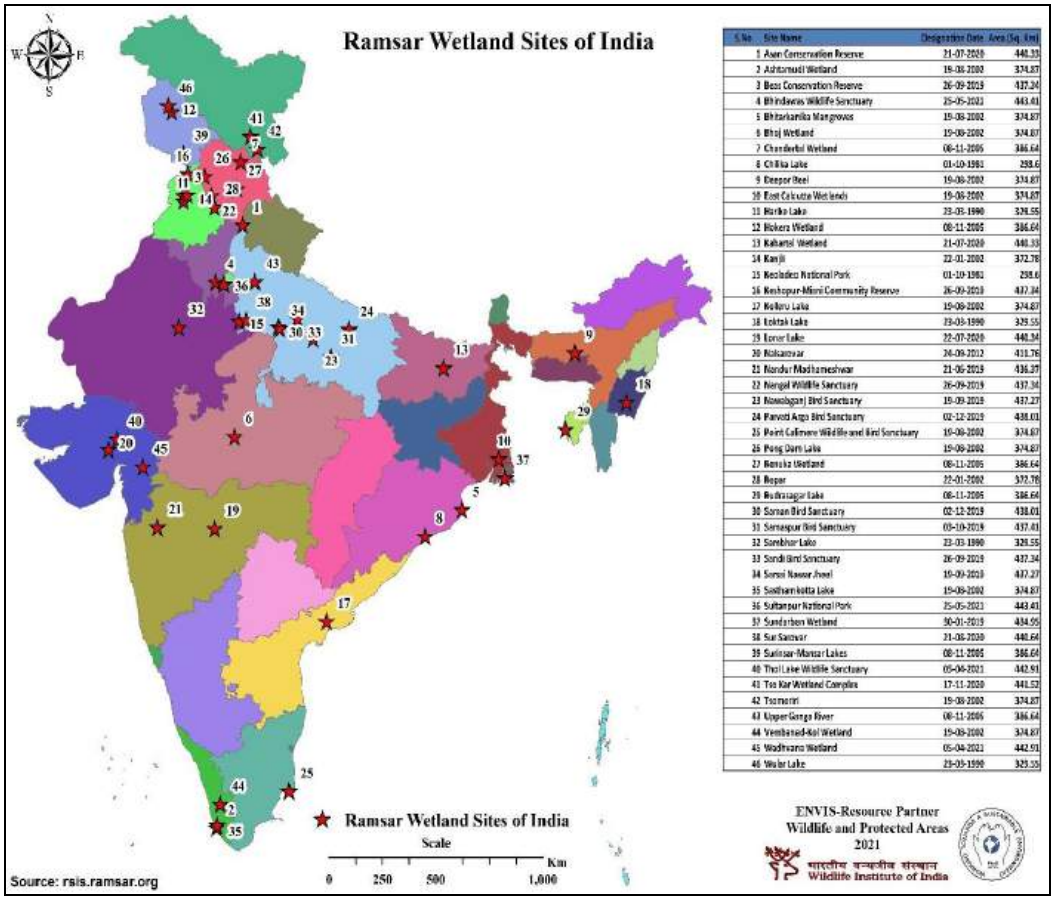


Figure- 7: Drainage map of Study area

2.5 Details of Wetlands/ Major Water Bodies

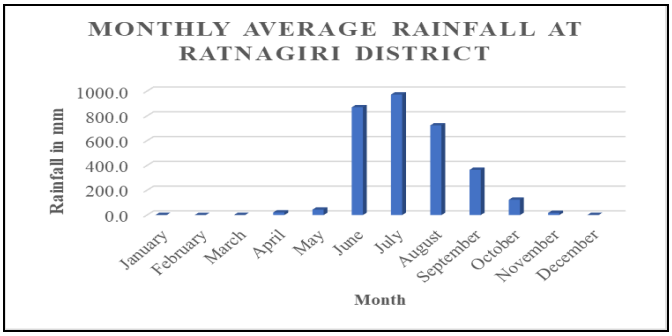
No protected wetlands/Ramsar sites/NLCP lake or any important wetland is located inside the buffer zone of this project. An undertaking that the project area is located more than 500 m away from the periphery of any demarcated wetland area.

As shown in figure below, the study area does not have any wetland, RAMSAR site, NLCP lakes etc. on which any dependence of local community takes place.



S.No	Site Name	Designation Date	Area (Sq. Km)
1	Asan Conservation Reserve	21-07-2020	440.33
2	Ashtamudi Wetland	19-08-2002	374.87
3	Beas Conservation Reserve	26-09-2019	437.34
4	Bhindawas Wildlife Sanctuary	25-05-2021	443.41
5	Bhitarkanika Mangroves	19-08-2002	374.87
6	Bhoj Wetland	19-08-2002	374.87
7	Chandertal Wetland	08-11-2005	386.64
8	Chilika Lake	01-10-1981	298.6
9	Deepor Beel	19-08-2002	374.87
10	East Calcutta Wetlands	19-08-2002	374.87
11	Harike Lake	23-03-1990	329.55
12	Hokera Wetland	08-11-2005	386.64
13	Kabartal Wetland	21-07-2020	440.33
14	Kanji	22-01-2002	372.78
15	Keoladeo National Park	01-10-1981	298.6
16	Keshopur-Miani Community Reserve	26-09-2019	437.34
17	Kolleru Lake	19-08-2002	374.87
18	Loktak Lake	23-03-1990	329.55
19	Lonar Lake	22-07-2020	440.34
20	Nalsarovar	24-09-2012	410.76
21	Nandur Madhameshwar	21-06-2019	436.27
22	Nangal Wildlife Sanctuary	26-09-2019	437.34
23	Nawabganj Bird Sanctuary	19-09-2019	437.27
24	Parvati Agra Bird Sanctuary	02-12-2019	438.01
25	Point Calimere Wildlife and Bird Sanctuary	19-08-2002	374.87
26	Pong Dam Lake	19-08-2002	374.87
27	Renuka Wetland	08-11-2005	386.64
28	Ropar	22-01-2002	372.78
29	Rudrasagar Lake	08-11-2005	386.64
30	Sarsai Bird Sanctuary	02-12-2019	438.01
31	Sarsaipur Bird Sanctuary	03-10-2019	437.41
32	Sasthbar Lake	23-03-1990	329.55
33	Sandi Bird Sanctuary	26-09-2019	437.34
34	Sarsai Nawar Jheel	19-09-2019	437.27
35	Sasthamkotta Lake	19-08-2002	374.87
36	Sultanpur National Park	25-05-2021	443.41
37	Sundarbans Wetland	30-01-2019	434.55
38	Surinsar	21-06-2020	440.64
39	Surinsar-Mansar Lakes	08-11-2005	386.64
40	Thol Lake Wildlife Sanctuary	05-06-2021	442.91
41	Tso Kar Wetland Complex	17-11-2020	441.52
42	Tsomoriri	19-08-2002	374.87
43	Upper Ganga River	08-11-2005	386.64
44	Vembanad-Kol Wetland	19-08-2002	374.87
45	Wadhvana Wetland	05-04-2021	442.91
46	Wular Lake	23-03-1990	329.55

Climate: The climate of the district is characterized by a hot summer and a general dryness throughout the year except during the south west monsoon season, which is from June to September while October and November constitute the post-monsoon season. Maximum temperature at the coast rarely goes beyond 38°C and in the interior, it seldom crosses 40°C owing to proximity to the sea. The normal rainfall of Ratnagiri district is 3137.20 mm.



3. HYDROGEOLOGY OF THE AREA

3.1 Geological Set up

Regional Geology

Regionally the area is covered with Basaltic flows of Deccan Basalts lavas of Upper Cretaceous to Paleogene age. The plateau tops along with coast are covered by Laterite. Quaternary formations comprising clay, silt cover the laterite and basalts at few places along the coast. The Deccan Basalts of the study area has been grouped under the Sahyadri Group and is divisible into two formations. The Diveghat Formation is confined to eastern half of the study area up to Panchpandri in South. This formation consists mainly 'aa' and simple type of flows. The overlying Purandargarh Formation is seen at 300 to 350 m amsl. A near horizontal disposition of the basalt flows along the continental divide is significant. Flow gradient is towards westerly. Structurally the area is disturbed as an evident lineament observed in the eastern part of the study area trending N-S direction. Laterite spread covering the Deccan Traps are noticed in vast areas of the study. Bauxite deposits are present in the study area near Umbershet and Rowale. Bauxite occurrences are also reported from Anjarle, Kavdoli, Umberghat and Utambar. Bauxite deposits on the plateaux are of blanket type and mostly covered with laterite capping. Western part of the study area belongs to Arabian Sea. Geological map of the study area is shown in ***Figure-8.*** A generalized lithological succession as established by the GSI is presented in **Table-3**.

Table 3: Lithology of the Study area:

Lithology	Geological Formation	Group	Age
Laterite		Quartenary	Cainozoic
Basalt	Purandagarh Formation	Sahayadri Group (Deccan Trap)	Upper Cretaceous to Paleogene
Basalt	Diveghat Formation		

Source: *DRM-Ratnagiri, Maharashtra., published by GSI.*

Geology of the project area: The project area is occupied by Lateritic Bauxite ore capping and underlying Basalt. A sequence of Deccan Trap Flows `capped bt laterite constitute the geological formation in the area. The laterite capping contains Bauxite zones with clays at the base of the laterite. The Deccan lava flows which are generally massive.

Geological Succession of the project area

I. Laterite with Bauxite horizon
II. Deccan Trap Basalt

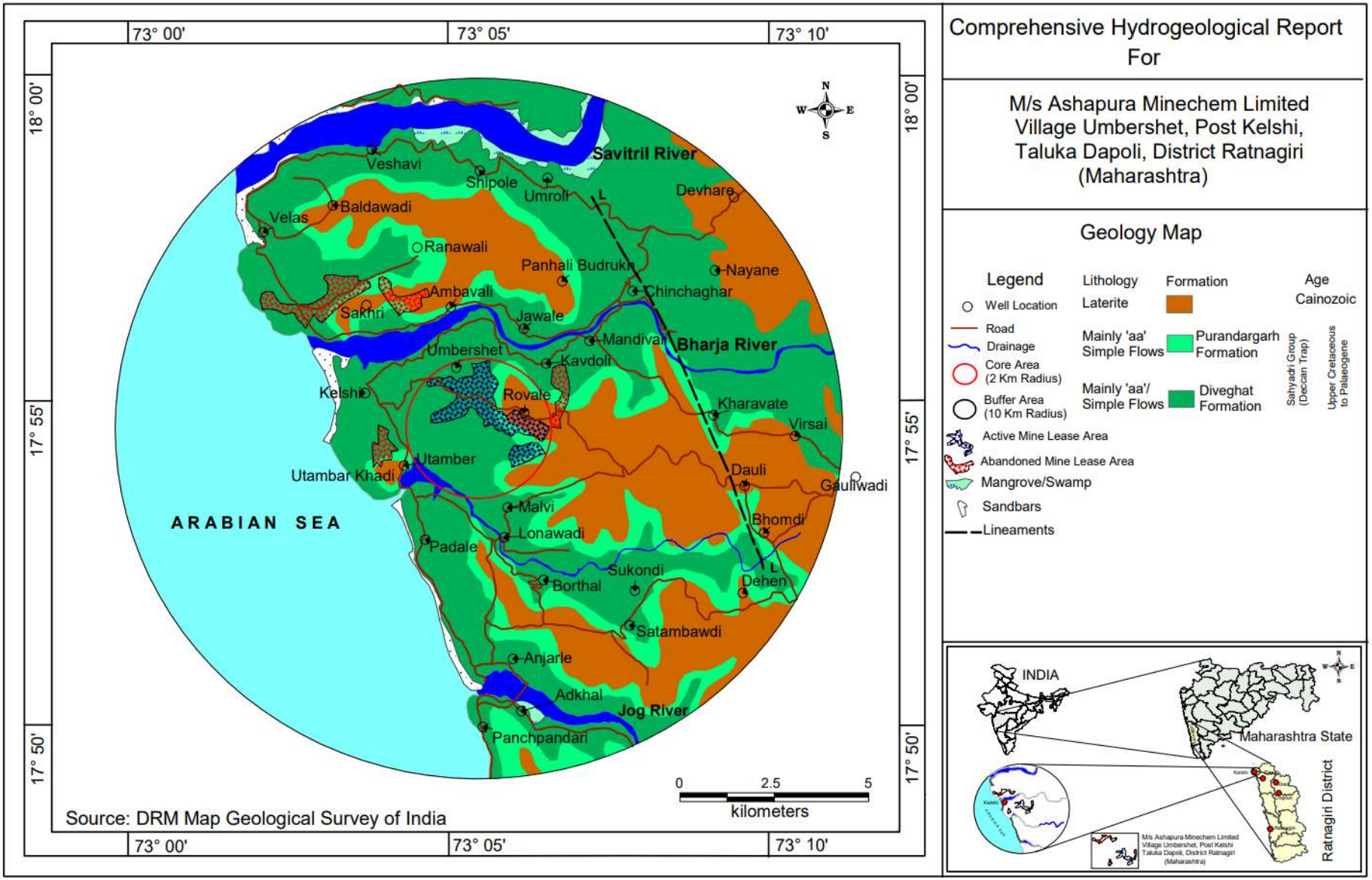


Figure-8: Geology map of the study area

3.2 Geophysical Studies

Geo-electrical approach plays a vital role in groundwater prospecting and proved to be most successful. An attempt has been made to decipher groundwater potential zones in the Laterite, Bauxite and Basalt around the Umbershet and Rowale villages. The aquifer materials are highly heterogeneous in character showing both vertical and lateral variations. VES Were conducted employing the Schlumberger array with 130 m maximum AB/2 separation using IGIS resistivity meter to delineate potential zones of groundwater occurrences. In lease area to know different layer parameters such as the number of sub-surface layers, their resistivities and thickness, depth of water bearing zones and depth of bedrock. This data has been used as a reference for interpreting the VES curves obtained in the area. The resistivity measurements were carefully interpreted by using curve matching technique. The VES curves are of A, H and K-type and are 3-3 layers of varying resistivity and thickness. The layer parameters obtained through interpretation of VES curves corroborates with the lithology of the area.

3.2.1 Resistivity sounding method- The basic operating principal of electrical resistivity surreys involves generating a direct current between two metal electrodes implanted in the ground, while the ground voltage is measured between two additional implanted electrodes. Given the current flow and measured voltage drop between two electrodes, the subsurface resistivity between the electrodes can be determined and mapped results of electrical resistivity survey are based on a computer-generated inverse model of measurements made in the field and are referred to as the apparent resistivity. Resistivity profiles detect vertical and lateral variations in resistivity in the subsurface. Electrical resistivity sounding method is employed for vertical investigation of subsurface geological layers. It is also called Vertical Electrical Sounding (VES), with this method, depths and thickness of various subsurface layers and their relative water yielding capabilities can be inferred.

3.2.2 Results of Geophysical analysis [vertical electrical sounding (VES),

Geophysical investigations comprise of vertical electrical soundings carried out to know the depth and thickness of water bearing zone at lease area. Vertical electrical soundings were conducted to collect the electrical resistivity data. Maximum electrode spacing between two current electrodes was kept 130 m. Details of resistivity survey

conducted at Umbershet and Rowale Mines are given in **Table- 4a & 4b** and data plot is shown in ***Figure -9a & 9b.***

Table -4a; Details of Resistivity Survey at Rowale Bauxite Mine and Umbershet Bauxite Mine

Depth	Constants	Constant	VES-1 at Near Office Rowale Mine		VES-2 at Umbershet Mine area	
			Lat.17.91865°	Long.: 73.1026633°	Lat. 17.920833°	Long.: 73.086667°
AB/2	MN/2	K	Reading	Average ρ	Reading	Average ρ
3	0.6	22.6286	5.690	128.757	6.89	155.911
5	1	37.7143	3.630	136.903	2.780	104.846
10	2	75.4286	3.41	257.211	2.580	194.606
15	3	113.1429	2.420	273.806	1.820	205.920
20	4	150.8571	1.820	274.56	1.370	206.674
25	5	188.5714	1.530	288.51	1.11	209.314
30	6	226.2857	1.310	296.43	0.87	196.869
40	8	301.7143	0.970	292.66	0.64	193.097
50	10	377.1429	0.780	294.17	0.51	192.343
60	12	452.5714	0.670	303.22	0.38	171.977
70	14	528.0000	0.580	306.24	0.36	190.080
80	16	603.4286	0.480	289.65	0.27	162.926
90	18	678.8571	0.370	251.18	0.21	142.560
100	20	754.2857	0.310	233.83	0.17	128.229
110	22	829.7143	0.270	224.02	0.13	107.863
120	25	865.8571	0.210	181.83	0.1	86.586
130	28	904.4694	0.170	153.76	0.08	72.358

Table- 4b : Details of Resistivity Survey at Rowale Bauxite Mine and Umbershet Bauxite Mine

VES -1 at Rowale Mine			
Layer	**Apparent Resistivity of layer (ohm-m)**	**Thickness of layer (in m)**	**Depth (m)**
Layer -1	297	18.8	18.8
Layer -2	200	54.5	73.3

Layer -3	58	5.2	78.5
Layer -4	56		
VES-2 at Umbershet Mine			
Layer	**Apparent Resistivity of layer (ohm-m)**	**Thickness of layer (in m)**	**Depth (m)**
Layer -1	200	41	41
Layer -2	100	19	60
Layer -3	90	13	73
Layer -4	26		

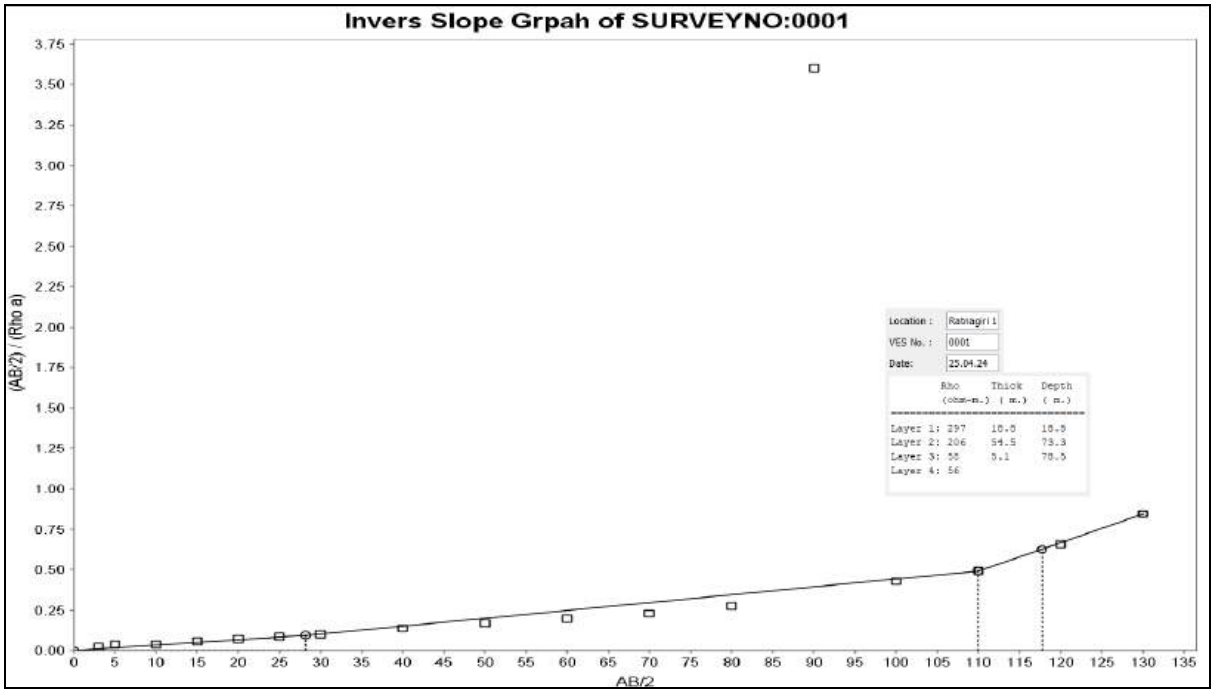


Figure-9a: Details Of Resistivity Survey Rowale Mine site

VES -1 at Rowale Mine , Near Office: Resistivity value recorded near mine office. The laterite thickness is recorded upto 18.8 m depth, than get high resistivity values between 18.8 to 73.3 m depth because massive basalt formation. The Mine operation is confined up 4 m bgl during current five year development.

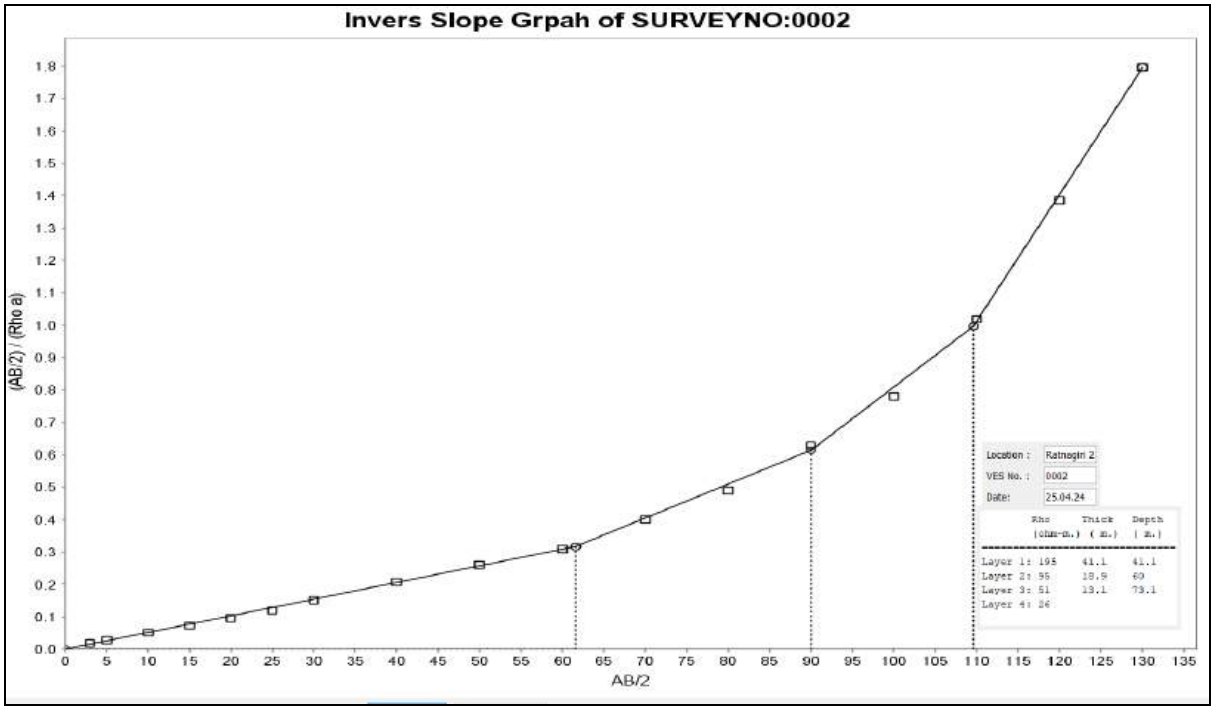


Figure-9b: Details Of Resistivity Survey at Umbershet Mine.

VES-2 at Umbershet Mine pit : Resistivity value recorded in near mine pit. The soil, laterite thickness is upto 41 m bgl, The high resistivity value recorded between surface to 41 m bgl shows that is massive form of laterite along with bauxite and bauxitic clay is encountered, than get low resistivity values between 41 to 60 m bgl due to vesicular basalt formation. The Mine operation is confined up 6 m bgl during current five year development.

3.3 Hydrogeological Setup

In Hydrogeological studies, observations were made about geology of the project area and the surrounding area. Studies were also done to know the types of aquifer systems. The hydrogeological frame work of the area is entirely controlled by geological set up, intensity and distribution pattern of rain fall and the degree of primary and secondary porosities developed in the prevailing geological formations for storage and movement of ground water. The present area under investigation is mainly occupied by lateritic soil of quaternary age and Deccan Trap Basalt of cretaceous to Paleogene period. Weathered mantle and shear zones laterite and basalt forms main aquifer. Groundwater occurs under unconfined conditions. The groundwater restricted to weather mantle and shear zones. The fracture and joints are wide near surface or just below the weathered mantle. Intense weathering in basalt and mineralization of Bauxite results in production of impervious clayey matrix.

Development of minor lineament is a witness of low degree tectonic deformations, which are more or less responsible for deep seated fracture systems.

Occurrence of ground water

In Hydrogeological studies, observations were made about geology of the project area and the surrounding area. Studies were also done to know the types of aquifers, surface drainage pattern, yields, quality etc. The well inventoried was carried out in the study area by collecting primary and secondary data from 34 numbers presented in **Table-5** of observation well within and outside buffer zone during 9th to 11th April 2024. The water level data of Post monsoon season-2023 are recorded from local inquiry. The water level data utilized for study is recorded/collected as well as reported.

The water table configuration, ground water flow pattern and yield of aquifers, water divide etc. present in the study area has been deciphered on the basis of Hydrogeological map (indicating Pre monsoon groundwater table contour) which is given in ***Figure-10***. The area is also characterized by the presence of laterites which occur as capping over Basalt formations. Laterite occurs in the north, south and eastern part of the study area particularly project area as capping over Basalt rock formation it plays only minor role in hydrogeological set up of area. Ground water in general occurs under unconfined; semi confined & confined conditions. The occurrence & movement of ground water in different geological formations in described as below.

Deccan Trap Basalt

Major part of the study area is covered by basaltic lava flows of Upper Cretaceous to Paleogene age. The lava flows are predominantly of 'aa' type. Deccan Trap Basalt forms an important water bearing formation in the study area. The primary porosity in the vesicular units is negligible due to lack of interconnection and secondary filling. The secondary porosity due to cooling joints, partition planes, cracks and fissures play an important role in ground water circulation. Degree of weathering and topographic setting also plays a major role in respect of productivity. Weathered, jointed and fractured parts of Massive and Amygdaloidal Basalt forms the aquifer in the area. Vesicles found are invariably filled with secondary minerals with secondary mineral infillings, thereby reducing their role to almost nil in the storage and movement of ground water through the formation. In general, ground water occurs under water table conditions in shallow aquifer and semi-confined to confined conditions in deeper

aquifer. The unconfined aquifer is developed due to the weathering and jointing of upper flow in Basalt down to depth of 4.6 to 10 m bgl and the yield of the wells tapping such aquifer varies from 24 to 86 m3/day. Bore wells are not common in the study area due to poor ground water potential of deeper aquifers of Deccan Traps. Few shallow to medium deep bore wells have 1 to 2 set of fractures are encountered in the depth range of 45 to 72 meters constructed by gram panchayat and private resident for their domestic uses and their yield varies between 2.5 and 5 m3/ hr.

Laterite

Generally, laterite is occurred on elevated land surface in the study area and have better porosity due to intricate network of sinuous conduits making it porous formation. The ground water circulates through a network of voids and conduits, joints and fractures. During monsoon, these formations get saturated quickly with water. The lithomargic clay occurring at base act as aquiclude preventing further percolation of ground water and springs emerge at this contact due to lateral movement of ground water. Desaturation is also quick in this formation. Only dug wells are found in this formation tapping aquifer down to about 8.5 m and their yield varies from about 43 to 67 m3/day.

Sandbars/Alluvium

The Alluvial deposits are found along the coastal areas in few isolated patches having limited areal extent as Beach Sand.

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Table-5: Hydrogeological details of wells monitoring in study area:

Sl. No.	Village	Location	Owner	District	Block	Latitude	Longitude	Type BW/DW	Dia in m	Depth (m bmp)
1	Malvi	In Village	Gram Panchyat	Ratnagiri	Dapoli	17.889167°	73.098611°	Dugwell	2.5	10
2	Lonawadi	Shri Babulal Vitthal Huurdkar	Shri Babulal Vitthal Huurdka	Ratnagiri	Dapoli	17.881475°	73.097747°	Dugwell	2.73	7.5
3	Borthal	Shri Devendra Dhavre	Shri Devendra Dhavre	Ratnagiri	Dapoli	17.870642°	73.107893°	Bore well	0.152	71
4	Panchpandari	Near Ram Mandir Main Villag	Gram Panchyat	Ratnagiri	Dapoli	17.832778°	73.092222°	Dugwell	3.8	5.5
5	Adkhal	Vitesh Kadam	Gram Panchyat	Ratnagiri	Dapoli	17.836944°	73.102222°	Dugwell	3.1	6.3
6	Anjarle	Ganesh Mandir	Gram Panchyat	Ratnagiri	Dapoli	17.850278°	73.100000°	Dugwell	6.4	8.9
7	Padale	Shri Sunil Weldurkar	Gram Panchyat	Ratnagiri	Dapoli	17.880906°	73.077182°	Dugwell	2.4	5.8
8	Utamber	Near Hotel Konkanratan	Shri Shepi	Ratnagiri	Dapoli	17.899945°	73.071720°	Dugwell	1.6	5.46
9	Kelsi	In Gulmohar Resort	Gulmohar Resort	Ratnagiri	Dapoli	17.918512°	73.061590°	Dugwell	4.65	7.42
10	Kavdoli	Main Village	Shri Prakash Bhau Chinchag	Ratnagiri	Dapoli	17.926111°	73.108611°	Borewell	0.152	45
11	Mandivali	Main Village	Gram Panchyat	Ratnagiri	Dapoli	17.931915°	73.119871°	Borewell	0.152	60
12	Jawale	Near Jama Masjid	Jama Masjid	Ratnagiri	Dapoli	17.935000°	73.102778°	Borewell	0.152	76
13	Ambavali	Near ZP Adarsh School	Gram Panchyat	Ratnagiri	Dapoli	17.940555°	73.083891°	Dugwell	2.54	5.8
14	Sakhari	Near ZPPS School	Gram Panchyat	Ratnagiri	Dapoli	17.941111°	73.061944°	Dugwell	6.2	6.8
15	Velas	Main Village	Sahil, Ashok Daridkar	Ratnagiri	Dapoli	17.959783°	73.035125°	Dugwell	3.9	9.3
16	Veshavi	Main Road	Gram Panchyat	Ratnagiri	Dapoli	17.981057°	73.063270°	Dugwell	2.94	4.68
17	Shipole	I/f Sunil Prakash Jatav Home	Gram Panchyat	Ratnagiri	Dapoli	17.975556°	73.091389°	Borewell	0.152	76
18	Nayane	Main Road	Gram Panchyat	Ratnagiri	Dapoli	17.950000°	73.152500°	Borewell	0.125	45
19	Devhare	Main Road	Gram Panchyat	Ratnagiri	Dapoli	17.968770°	73.157462°	Dugwell	4.2	6.52
20	Umroli	Main Road	Gram Panchyat	Ratnagiri	Dapoli	17.973766°	73.108970°	Dugwell	3.8	5.85
21	Baldawadi	Main Road	Gram Panchyat	Ratnagiri	Dapoli	17.966668°	73.053220°	Borewell	0.152	75
22	Ranawali		Gram Panchyat	Ratnagiri	Dapoli	17.955886°	73.075133°	Dugwell	3.2	5.6
23	Panhali Budrukh	Main Village	Gram Panchyat	Ratnagiri	Dapoli	17.947222°	73.112778°	Borewell	0.152	76
24	Chinchaghar	In Village	Gram Panchyat	Ratnagiri	Dapoli	17.944722°	73.131111°	Dugwell	2.6	6.8
25	Umbershet	In Village	Gram Panchyat	Ratnagiri	Dapoli	17.925000°	73.085278°	Dugwell	5.8	7.13
26	Kharavate	In Village	Shri Milind Yashwant	Ratnagiri	Dapoli	17.912758°	73.152147°	Borewell	0.177	82
27	Virsai	Main Road	Gram Panchyat	Ratnagiri	Dapoli	17.907500°	73.173333°	Dugwell	2.42	3.5
28	Gauliwadi	Main Road	Shri Suraj Thakkar	Ratnagiri	Dapoli	17.897047°	73.189052°	Dugwell	4.39	7.8
29	Dauli	Near Sanskatik Bhawan	Shri Rajendra pratap jatav	Ratnagiri	Dapoli	17.894743°	73.160248°	Borewell	0.152	55
30	Bhomdi	Main Road	Gram Panchyat	Ratnagiri	Dapoli	17.882635°	73.165212°	Dugwell	4.86	8.5
31	Dehen	I/f of Ayushman Aarogya Ma	Ayushman Aarogya Mandir	Ratnagiri	Dapoli	17.867233°	73.159726°	Borewell	0.177	72
32	Sukondi	In Village	Gram Panchyat	Ratnagiri	Dapoli	17.867778°	73.131667°	Borewell	0.152	75
33	Satambawdi	Sai Dham Mandir Road	Gram Panchyat	Ratnagiri	Dapoli	17.858889°	73.130278°	Borewell	0.152	78
34	Rovale	In village near Mine		Ratnagiri	Dapoli	17.913368°	73.102873°	Bore well	0.177	76

Contd… Table-5: Hydrogeological details of wells monitoring in study area:

Sl. No.	Village	Reported Yield In m3/hr	Usage Irrigation / Domestic / Industry	Measured Water Level In Pre Moonsoon April 2024 (In m bgl)	Reported WaterLevel In - Post Moonsoon 2023 (In m bgl)	Flactuation (In m)	Altitude (m amsl)	WT Pre-2024	WT Post-2023
1	Malvi	1.3	Domestic	2.30	2.1	0.20	73	70.70	70.90
2	Lonawadi	2	Irrigation	2.01	1.6	0.41	4.9	2.89	3.30
3	Borthal	4.5	Domestic	13.38	11.3	2.08	63.3	49.92	52.00
4	Panchpandari	1.5	Domestic	5.02	2.6	2.42	9	3.98	6.40
5	Adkhal	1.3	Domestic	4.36	3.52	0.84	6	1.64	2.48
6	Anjarle	2.2	Domestic	4.78	3.1	1.68	12	7.22	8.90
7	Padale	1.6	Domestic	2.80	2.28	0.52	9.4	6.60	7.12
8	Utamber	1	Domestic	4.16	3.15	1.01	8.6	4.44	5.45
9	Kelsi	1.8	Domestic	3.28	2.95	0.33	15.2	11.92	12.25
10	Kavdoli	4.5	Domestic	5.10	3.42	1.68	10	4.90	6.58
11	Mandivali		Domestic	5.33	3.8	1.53	15.4	10.07	11.60
12	Jawale	3	Domestic	16.75	14.78	1.97	18	1.25	3.22
13	Ambavali	1.6	Domestic	3.12	1.26	1.86	9	5.88	7.74
14	Sakhari	2.8	Domestic	3.45	2.52	0.93	75	71.55	72.48
15	Velas	3.6	Domestic	3.50	2.9	0.60	12.7	9.20	9.80
16	Veshavi	1.2	Domestic	4.13	3.18	0.95	15.1	10.97	11.92
17	Shipole	3	Domestic	4.42	3.39	1.03	10	5.58	6.61
18	Nayane		Not in Use	7.20	4.3	2.90	186	178.80	181.70
19	Devhare	1.8	Domestic	4.07	3.05	1.02	223.7	219.63	220.65
20	Umroli	1.2	Domestic	3.30	2.14	1.16	62.4	59.10	60.26
21	Baldawadi	5	Domestic	10.32	8.6	1.72	152.2	141.88	143.60
22	Ranawali	1.2	Domestic	1.22	1	0.22	175.4	174.18	174.40
23	Panhali Budrukh	3.5	Domestic	13.56	11.6	1.96	126	112.44	114.40
24	Chinchaghar	1.6	Domestic	3.30	2.42	0.88	9	5.70	6.58
25	Umbershet	5.2	Domestic	3.35	2.19	1.16	151	147.65	148.81
26	Kharavate	2.1	Domestic	25.10	21.48	3.62	216.6	191.50	195.12
27	Virsai	1	Domestic	2.53	1.68	0.85	147	144.47	145.32
28	Gauliwadi	2.1	Domestic	6.39	4.37	2.02	185.7	179.31	181.33
29	Dauli	3	Domestic	19.03	15.68	3.35	215.9	196.87	200.22
30	Bhomdi	2.8	Domestic	1.84	1.5	0.34	182.4	180.56	180.90
31	Dehen		Domestic	13.63	11.6	2.03	228	214.37	216.40
32	Sukondi	3	Domestic	14.56	11.34	3.22	181	166.44	169.66
33	Satambawdi	2.5	Domestic	12.31	10.85	1.46	177	164.69	166.15
34	Rovale	5	Domestic	29.97	24.2	5.77	238.6	208.63	214.40
			Min.	**1.22**	**1**	**0.20**	**4.90**	**1.25**	**2.48**
			Max	**29.97**	**21.48**	**3.62**	**228.00**	**219.63**	**220.65**
			Avg.	**7.63**	**5.50**	**1.45**	**90.48**	**83.52**	**84.98**

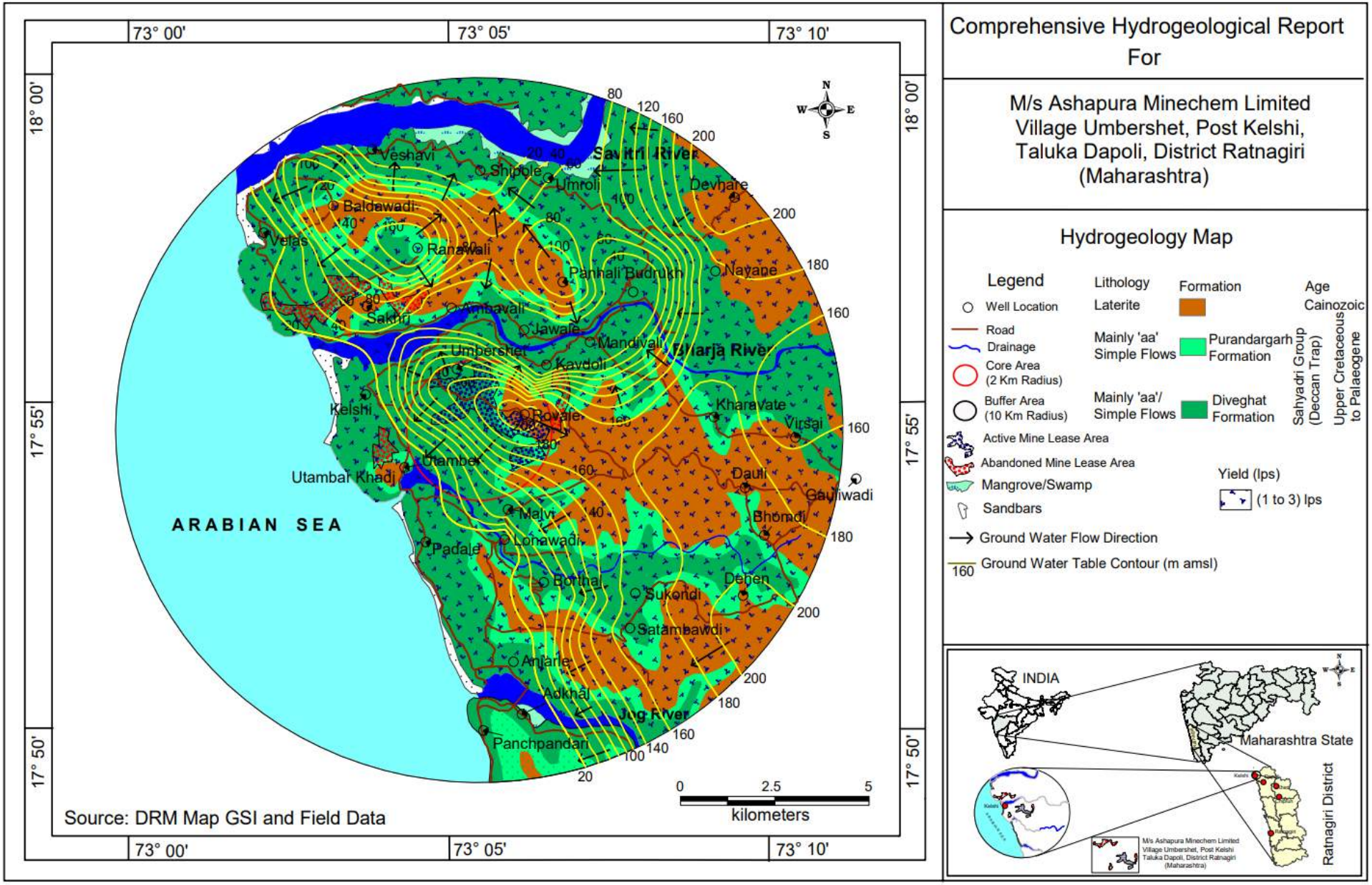


Figure - 10: Hydrogeology Map of the Study area

3.3.1 Aquifer Characteristics

The principal aquifers in the study area have been delineated as weathered, fractured Deccan Trap Basalt rock. Pumping test was conducted to assess the aquifer characteristics in the area. During Pumping test, the static water level in the well was measured in pumping well. Pumping was carried out for 300 minutes. Observation well was not available. The pumping test results presented in **Table-6.** The data recorded during the pumping test is given in **Table-7** and recuperation data shown in **Table-8**. The time V/s drawdown in main well and recovery data of pumping well, t / t' V/s RDD was plotted on semi logarithmic paper. A straight line matching the points was drawn to compute the value of drawdown in one log cycle.

Transmissivity (KD or T) is determined by using Jacob's straight-line method and following equation was used to compute Transmissivity.

Transmissivity: T = KD = 2.303Q/ 4π ΔS

Where Q is the yield of the bore well and Δ S is the difference in the draw down during two log cycle.

Computation of Transmissivity

The Transmissivity of aquifer was computed using Jacob's Method. The depth of pumping well an observation well is exploration of bore well 40 m which are been constructed by tapping deeper aquifer; it is assumed the thickness of aquifer which is single aquifer and it is homogenous in nature.

Thus, applying the formula

Transmissivity (T) = 2.303*Q/4πΔs

Where Q is discharge in m^3/day, Δs change in draw down over a log cycle

Pumping Well, Jacob's straight-line method

Discharge (Q) = 120 m^3/day

Δs = 13.67 m

T_1 = 2.303 x 120 / 4 x 3.14 x 13.67 = 276.36 / 171.69 =1.60 m^2/day

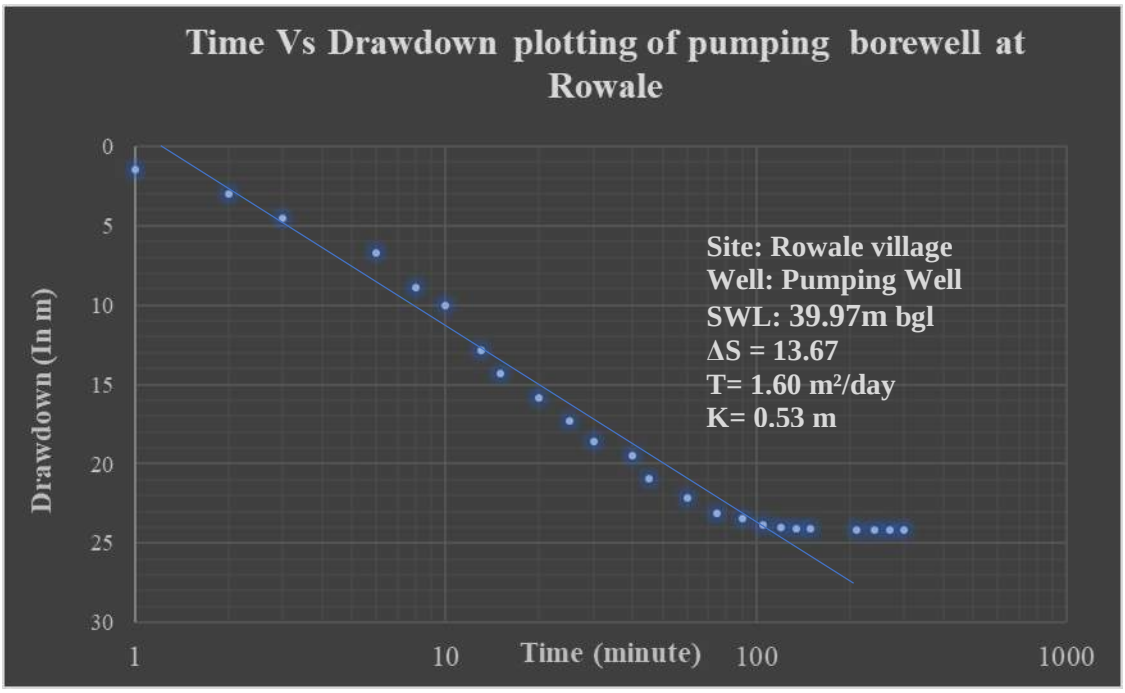


Figure-11*: *Data plot of DD v/s t in the pumping well

Pumping well, Theis's recovery method

Discharge (Q) = 120 m^3/day

Δs = 15.37 m

T_2 = 2.303 x 120 / 4 x 3.14 x 15.37 = 276.36 / 193.04 = 1.43 m^2/day

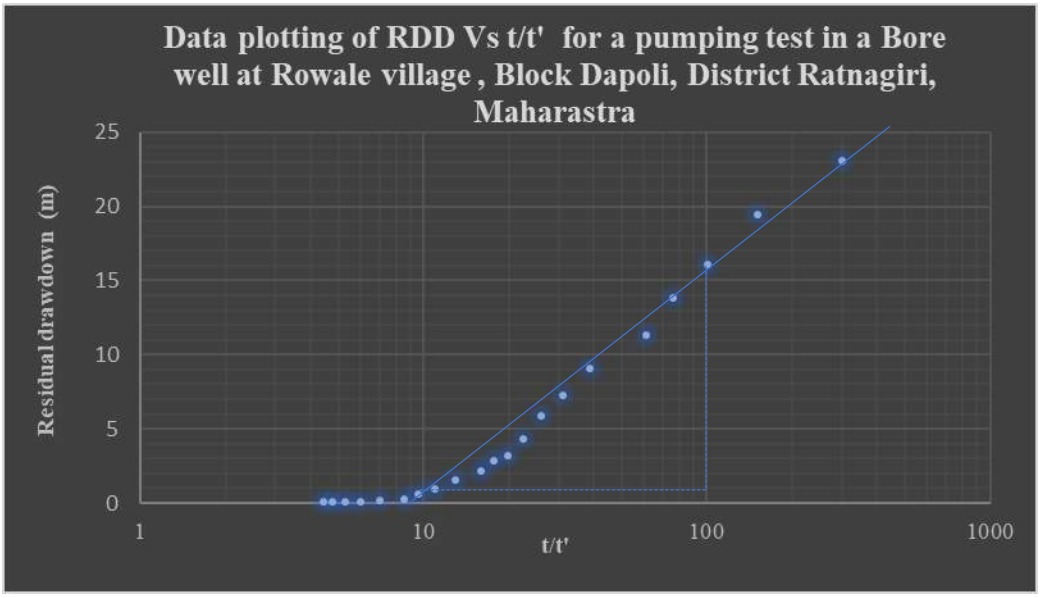


Figure-12*: *Data plot of RDD v/s t for pumping well

Table-6; Results of Pumping Test

Parameter	Pumping Well
Village	Rowale, Block Katni, District Katni
Formation	Laterite & Basalt
Depth of Bore well (m)	76
Duration (In minutes)	300
Static Water Level (In m bgl)	29.97
Measuring Point (In m agl)	0.5
Pumping Water Level (m)	54.1
Drawdown (m)	24.13
Distance of Observation Well from EW	Not available
Discharge (m^3/day)	120
Transmissivity (T) in m^2/day	T_1 = 1.60 m^2/day T_2 = 1.43 m^2/day
	Average = 1.51 m^2/day
Thickness of aquifer (In m)	3.00
Hydraulic Conductivity (K)	Average: 0.50 m/day

Table-7: Drawdown Data Recorded During Pumping

Time since pump started (min) t	DTW (m)	DD (m)	Time since pump started(min) t	DTW (m)	DD (m)
1	31.46	1.49	45	60.87	20.9
2	32.98	3.01	60	62.08	22.11
3	34.47	4.5	75	63.05	23.08
6	36.66	6.69	90	63.39	23.42
8	38.84	8.87	105	63.78	23.81
10	40.98	11.01	120	63.96	23.99
13	42.84	12.87	135	64.05	24.08
15	44.27	14.3	150	64.09	24.12
20	45.79	15.82	210	54.1	24.13
25	47.3	17.33	240	54.1	24.13
30	58.59	18.62	270	54.1	24.13
40	59.48	19.51	300	54.1	24.13

Table-8: Residual drawdown recorded during recovery

Time since pump started (t) (min)	Time since pump stopped (t') (min)	t/t'	Pumping Well	
			Water level	RDD
301	1	301	53.04	23.07
302	2	151	49.45	19.48
303	3	101	46.07	16.1
304	4	76	43.79	13.82
305	5	61	41.29	11.32

308	8	38.5	39.08	9.11
310	10	31	37.24	7.27
312	12	26	35.82	5.85
314	14	22.43	34.31	4.34
316	16	19.75	33.15	3.18
318	18	17.67	32.83	2.86
320	20	16	32.13	2.16
325	25	13	31.53	1.56
330	30	11	30.93	0.96
335	35	9.57	30.59	0.62
340	40	8.5	30.21	0.24
350	50	7	30.14	0.17
360	60	6	30.08	0.11
370	70	5.29	30.07	0.1
380	80	4.75	30.07	0.1
387	87	4.45	30.07	0.1

3.3.2 Ground water flow and aquifer interaction with surface water bodies

The water table configuration, ground water flow pattern and yield of aquifers, water divide indicate in the study area has been deciphered on the basis of Hydrogeological map (Pre monsoon groundwater table contour map) which is given in ***Figure-10.*** In general, the ground water movement is towards West i.e., towards Arabian sea. In area of low permeability, the water table contours are closely spaced indicating steep gradient. A maximum and minimum pre-monsoon groundwater table are 219.63 m amsl and 1.25 m amsl, respectively, whereas maximum post monsoon groundwater table is 220.65 m amsl and minimum 2.48 m amsl, indicating highly undulating terrain. Surface water divides on central part represents deep water levels. The gradient of water table is also variable. It is high near zone of surface water divides and low in remaining part of the study area. The ground water flow in southeast part of the buffer zone and also towards north with low hydraulic gradient as 0.00909 to 0.011764 m/m calculated from the monitoring of wells of the area. The average hydraulic gradient near mine is 0.055161085 m/m during pre-monsoon and 0.06006244871 m/m during post moon.

The ground water table configuration map prepared using the pre- and post-monsoon data specifies that there are two different flow patterns exists in the study area.

1) Flow towards the north and west which confirms the natural slope of the terrain.

2) Ground water mound (divergent flow of ground water).

From the mine site, the ground water flow is towards north and west.

The ground water table generated using the pre and post monsoon data indicates that the Ground water flow towards north and west from the mine area. Pre monsoon ground water table map is presented in ***Figure-13***. The same flow pattern is observed during the post monsoon period. However, that there is change in the hydraulic gradient. Post monsoon ground water table map is presented in ***Figure-14***.

The ground water aquifer interaction with surface water bodies is observed along the Savitri River and Bharja River. The small streams and nallahs flowing within the buffer zone are intermittent and flow is only observed during monsoon season and no or negligibly small interaction might be occurring. All the drainage present over the area is effluent in nature which indicates that during lean periods ground water contributes to the river.

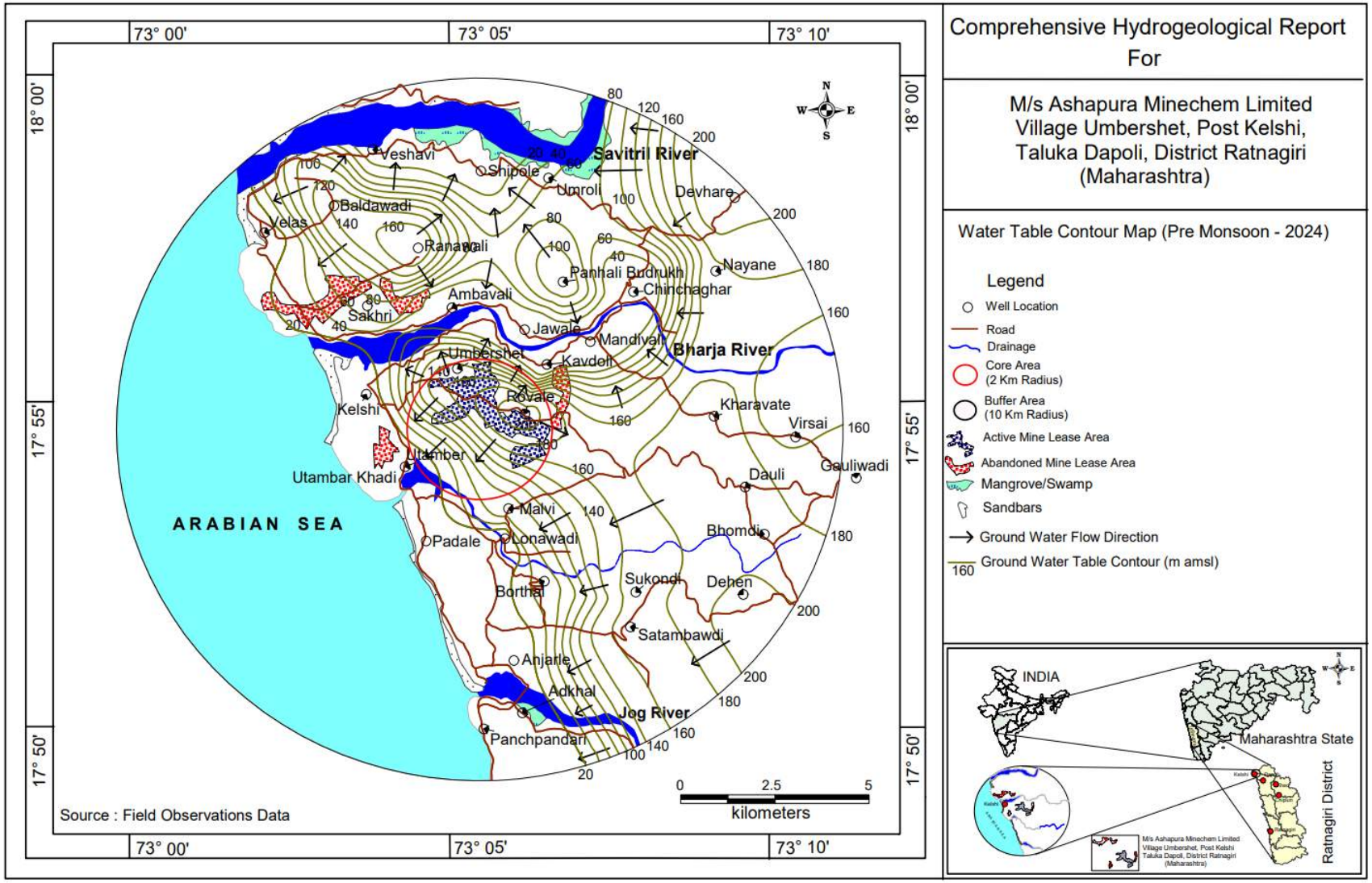


Figure-13: Pre monsoon ground water table map

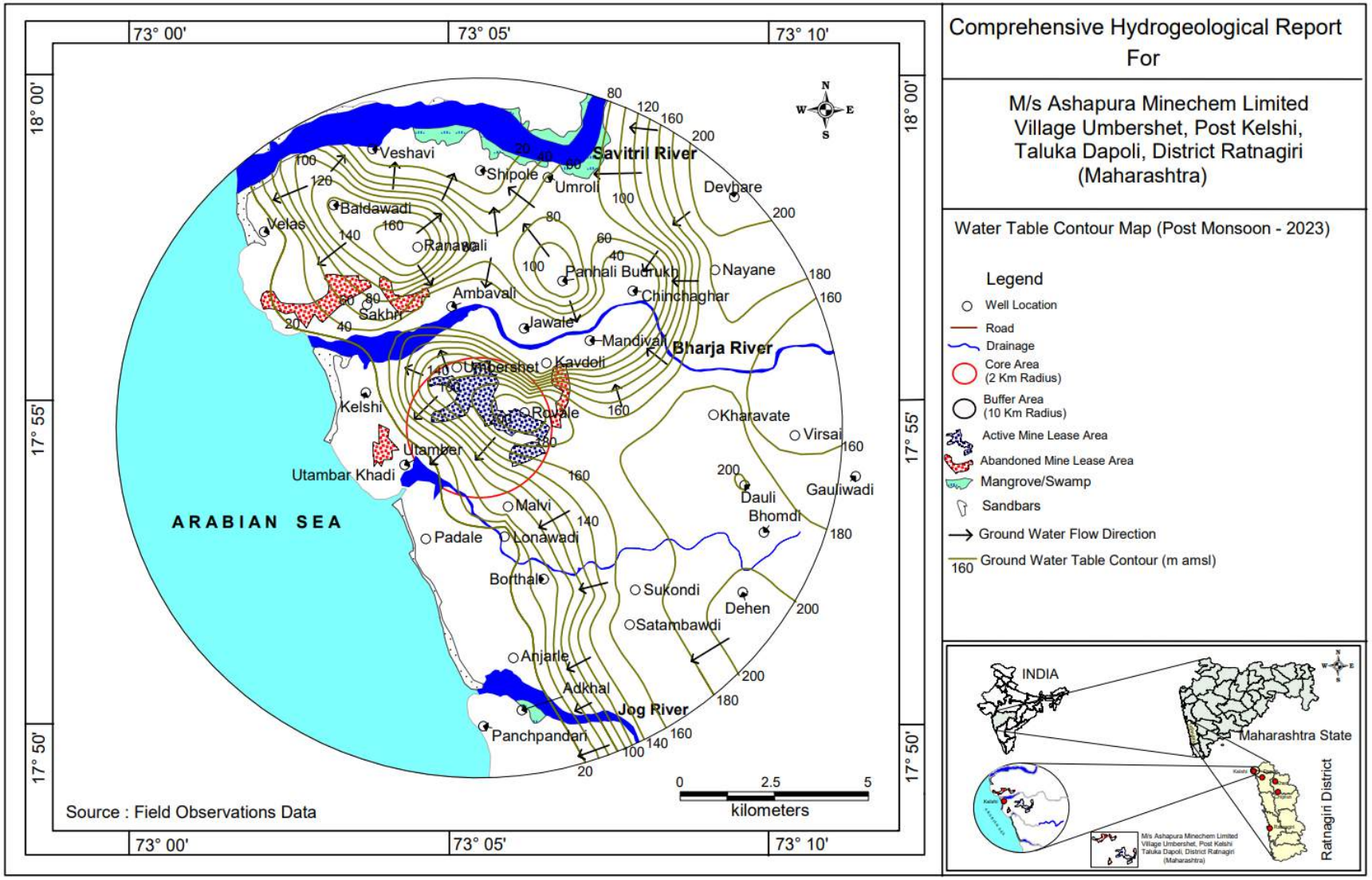


Figure-14: Post monsoon ground water table map

3.3.3 Depth to water level:

In order to decipher the behavior of the ground water regime, depth to water levels and fluctuation, the water level monitoring was carried out in the study area by collecting primary and secondary data of observation well within (10 km radius from Mine site) and outside study area during pre-monsoon 2024. The water level data of post-monsoon season-2023 are recorded from local enquiries. The water level data utilized for study is recorded/collected as well as reported. The water level data utilized for study is recorded as well reported. In the study area total 34 number of observation wells (refer **Table-5** in foregoing para) comprising 13 numbers of borewells and 21 numbers dug wells at different villages were established as key observation for monitoring purposes. The location of key observation well map shown in ***Figure-15***. On the basis of water level data maps are prepared to represent the pre-monsoon season in ***Figure-16,*** depth to water level post-monsoon depicted in ***Figure-17*** and seasonal fluctuation map shown in ***Figure-18.***

Summarized ground water levels in Bore well in core and buffer zone is tabulated as below:

	Water level (m bgl)		
Parameters	**Pre-monsoon**	**Post-monsoon**	**Fluctuation in pre and post monsoon**
Minimum	1.22	1	0.20
Maximum	29.97	21.48	3.62

Pre-monsoon Water level: The pre monsoon depth to ground water level depict that relatively deepest of ground water level zone of 10 to 30 m falls in the central, middle-east and southeast part of the study near Rowale, Panhali Budrakh, Jawale, Sukondi Borthal, Dehen, Satambawadi and Kharavate villages. The shallow ground water level zone of 2 to 10 m bgl occupies in the south, northern and eastern part of the study area near Panchpandri, Anjarle, Padale, Kelshi, Sakari, Velas, Veshavi , Devhare, Bhomdi and Virsai villages.

Post-monsoon Water level: The post-monsoon depth to ground water level zone of 10 to 25 m falls in central, middle east and southeast part of the study. The shallow ground water level zone of 2 to 10 m occupies near Panchpandri, Anjarle, Padale, Kelshi, Sakari, Velas, Veshavi , Devhare, Bhomdi and Virsai villages in south, northern and east part of the study area. During the post monsoon period there is considerable rise in the ground water level.

Fluctuation in water level: Pre (2024) and post monsoon (2023) water levels were considered for evaluation of seasonal fluctuation in water level. Fluctuation in water level varies from < 2 to 4 m. which indicates that the aquifer of the study area has moderate recharge potential. The Core zone falls in 2 to 4 m fluctuation zone.

Some field photographs are shown as below.

Geotagged Photographs of well monitoring during field visit

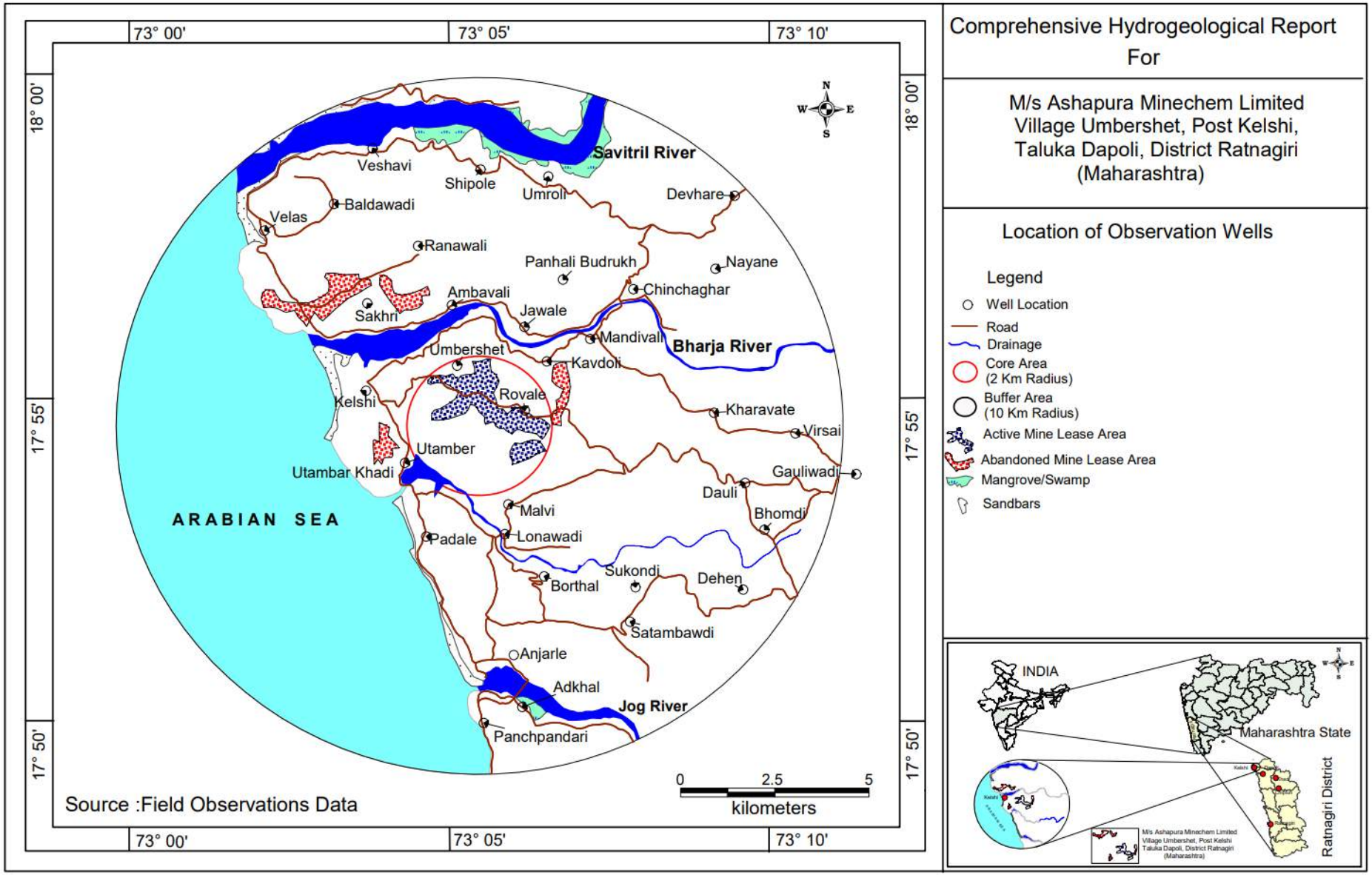


Figure -15 : Location of Key Observation Well Map

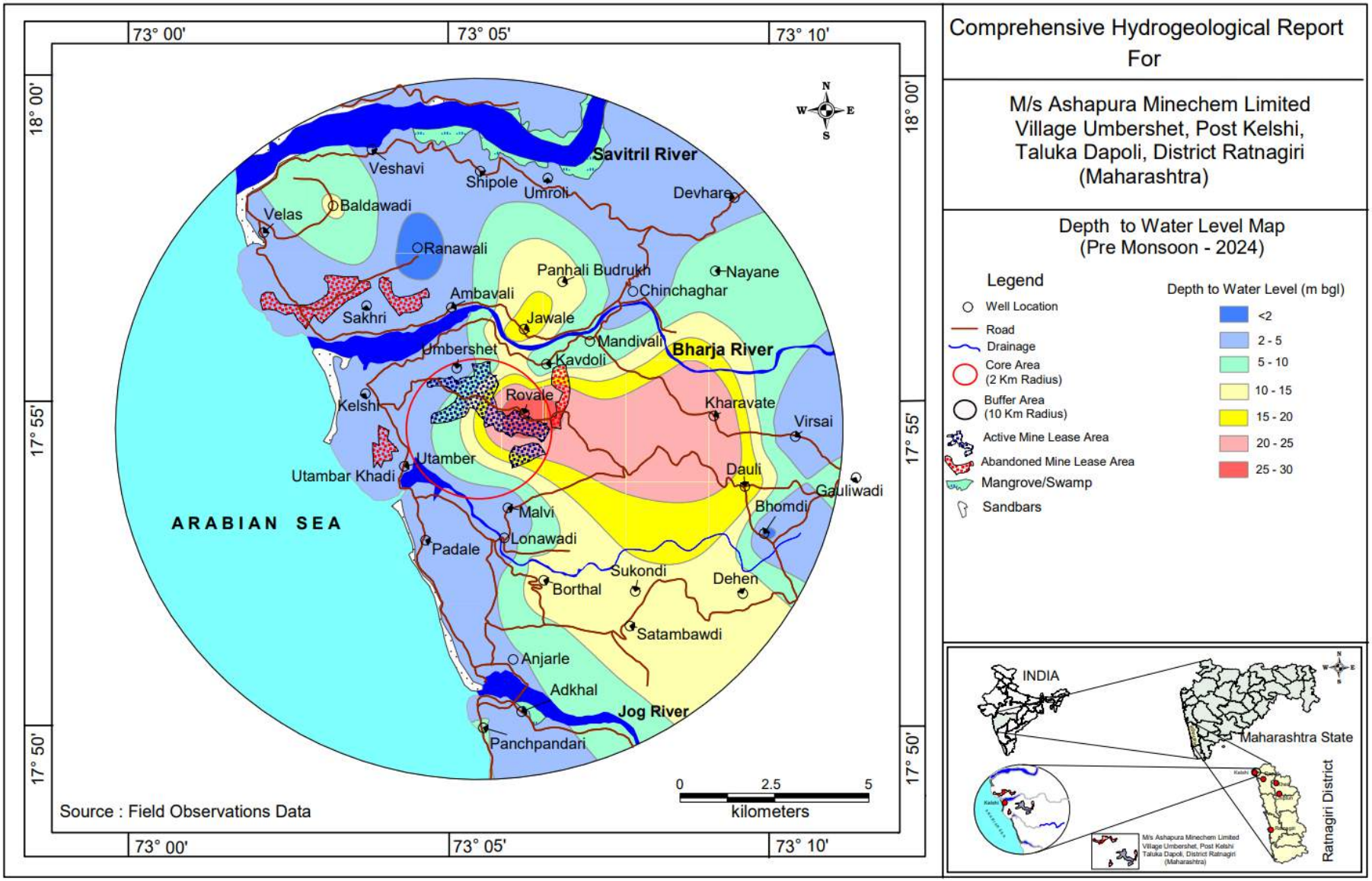


Figure -16: Depth to water level map Pre monsoon 2024(April-2024) of the Study area

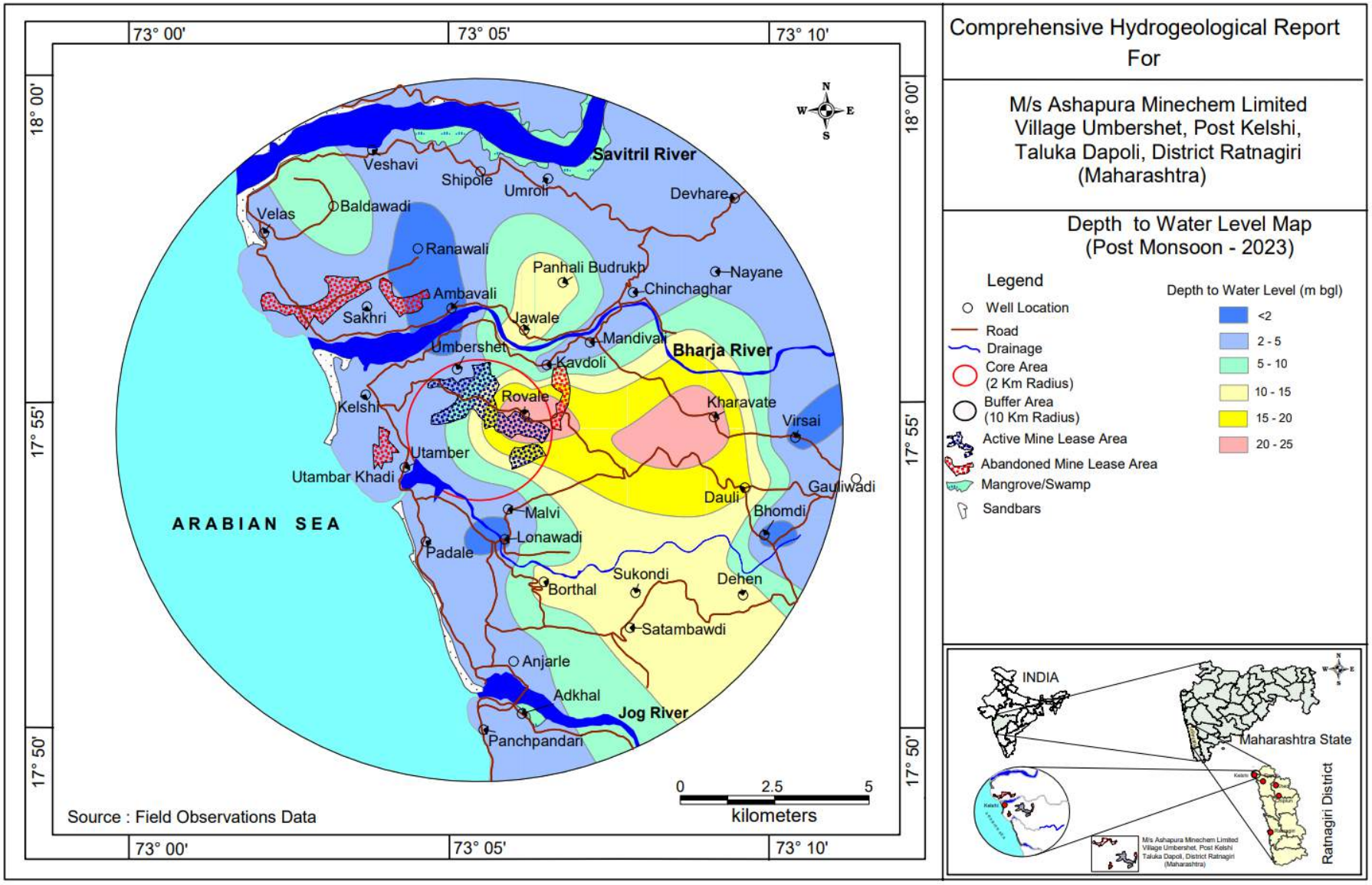


Figure -17 : Depth to Water Level Map Post Monsoon (November 2023) of the Study area

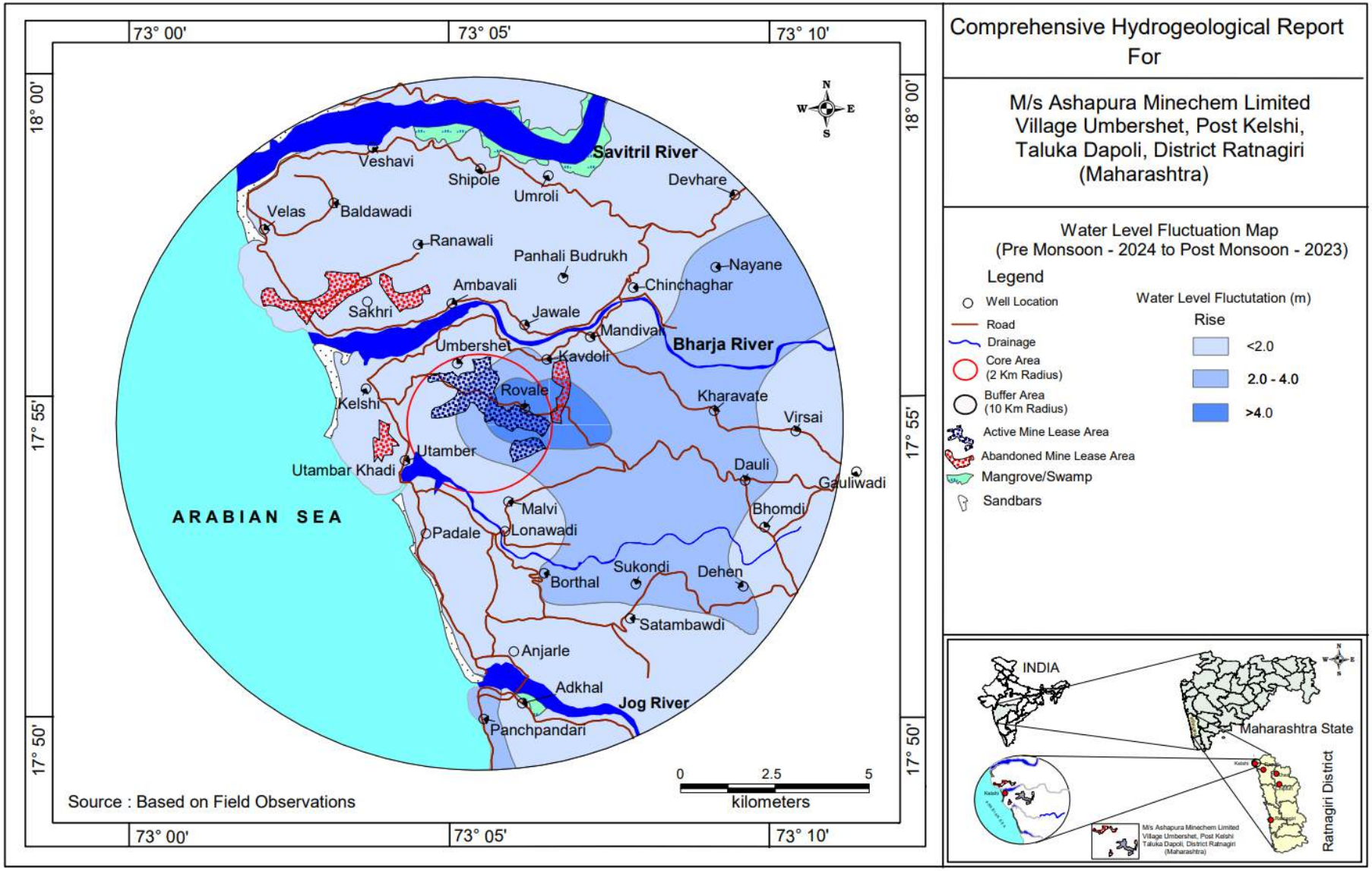


Figure-18: Water Level Fluctuation Map Pre-Monsoon to Post Monsoon (April -2024 to November -2023)

3.3.4 Long term water level data analysis

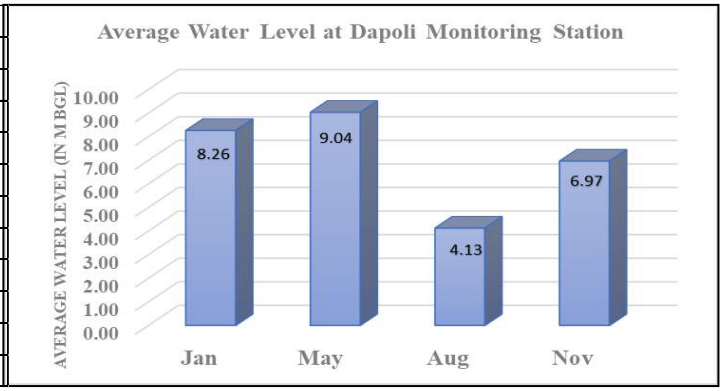
There is no observation well of CGWB in the study area (10 km buffer zone) of Ashapura Minechem Limited, Umbershet & Rowale Bauxite Mine area. In order to understand the long term (10 years) ground water level changes, the CGWB observation wells 3 Nos located nearby the study area has been considered for trend analysis which is downloaded from *https://indiawris.gov.in/* web site. The geographic coordinate of the monitoring well as follows.

Table-9: Geographic location of CGWB Monitoring wells:

S. N.	Location	Block	District	Latitude	Longitude	Direction from Project Site	Distance from Mine Lease Boundary (In km)
1	Dapoli	Dapoli	Ratnagairi	17.75898°	73.18926°	South	20
2	Jalgaon	Dapoli	Ratnagairi	17.73474°	73.19809°	South	23
3	Visapur	Dapoli	Ratnagairi	17.86629°	73.31813°	East	25

Table -10: Dapoli Monitoring Well Data from 2013 to 2022

Year	Jan	May	Aug	Nov
2013	8.02	8	5.15	6.7
2014	6.45	8.4	1.65	7.25
2015	9.05	8.8	7.5	7
2016		10.45	2.9	6.9
2017	7.9	10.45	2.75	6.95
2018	7.2	9		
2019	9.3		2.4	6.45
2020	11.2			5.8
2021	7.25		3.65	8.65
2022	8	8.15	7	7
Avg.	**8.26**	**9.04**	**4.13**	**6.97**



Data Source: https://indiawris.gov.in/wris/#/groundwater

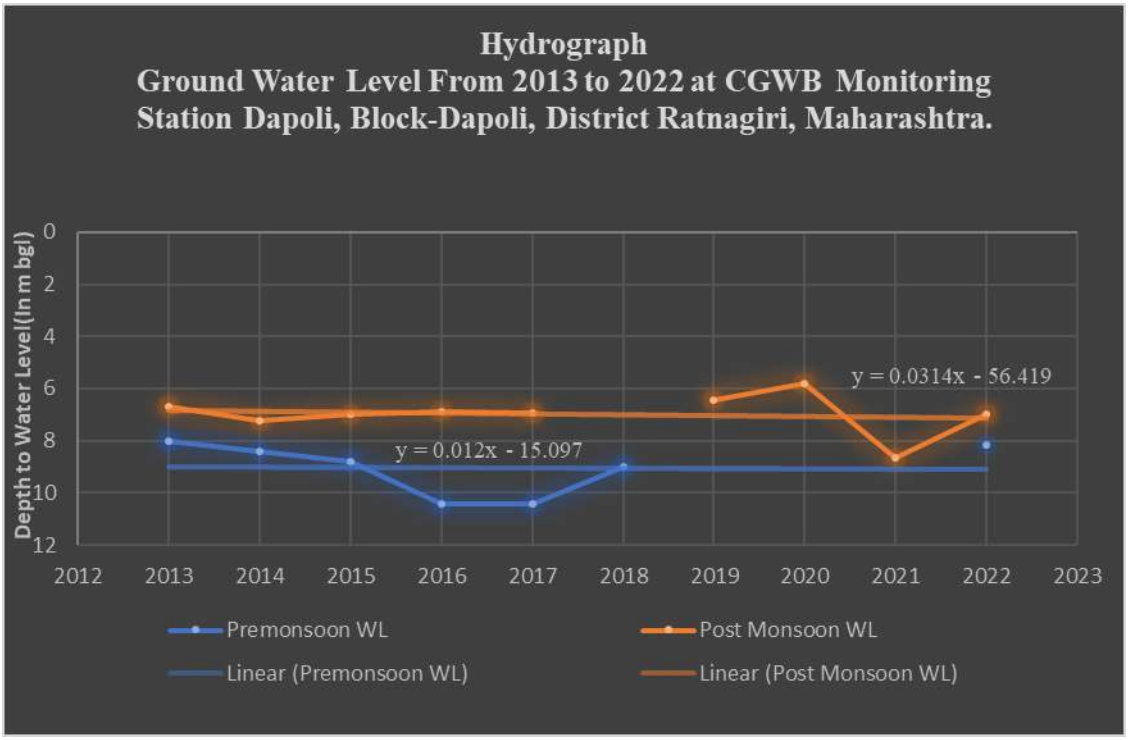
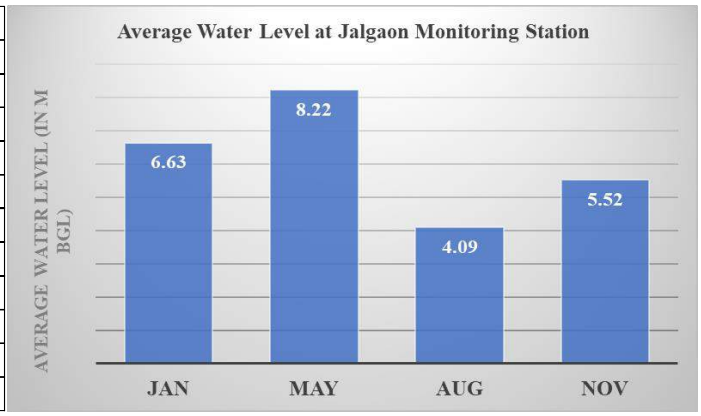


Figure-19: Ground Water Level Trend during Pre and Post Monsoon at Dapoli Monitoring Station

Table -11: Jalgaon Monitoring Well Data from 2013 to 2022.

Year	Jan	May	Aug	Nov
2013	6.8	8.72	4.06	5.17
2014	6.12	8.06	2.32	5.98
2015	6.67	7.79	4.84	5.66
2016	6.56	8.69	4.68	5.71
2017	6.3	9.51	4.58	5.46
2018	5.78	7.99	3.32	5.36
2019	7.1	7.69	4.25	5.26
2020	7.22	7.73	4.28	5.25
2021	6.74	7.78	3.78	5.95
2022	7.05	8.26	4.78	5.38
Avg.	**6.63**	**8.22**	**4.09**	**5.52**



Note: 1. Underlined is the missing data, filled based on interpolation.
2. Data Source: https://indiawris.gov.in/wris/#/groundwater.

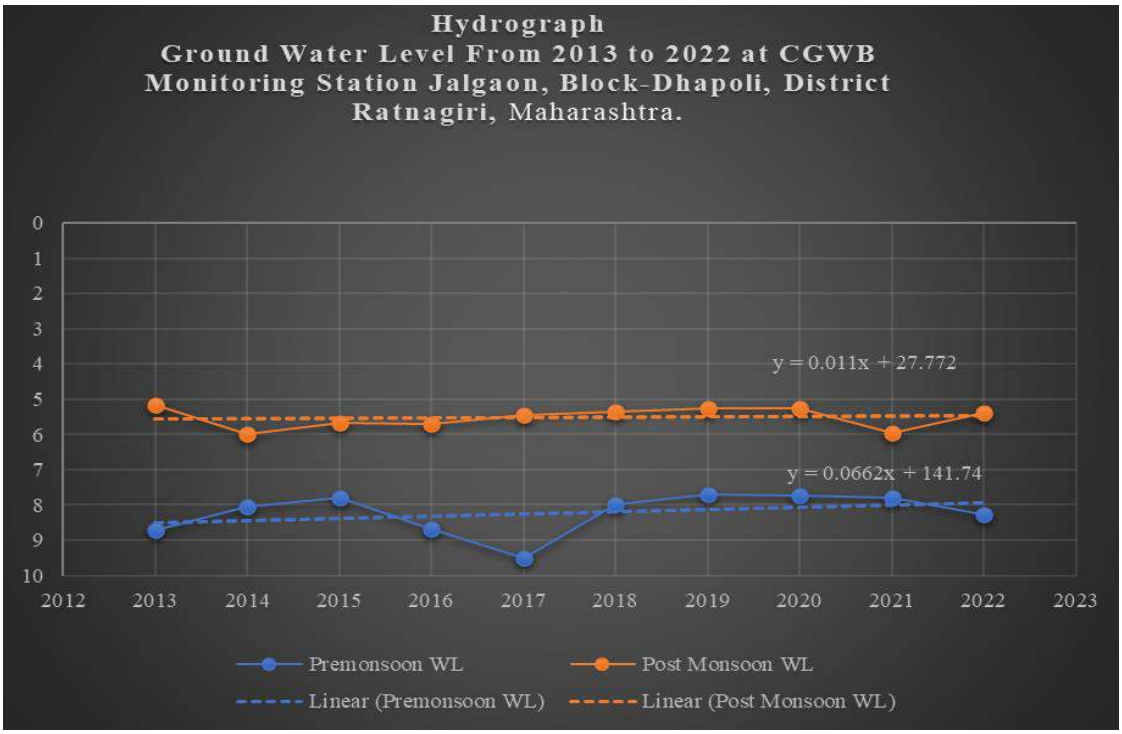
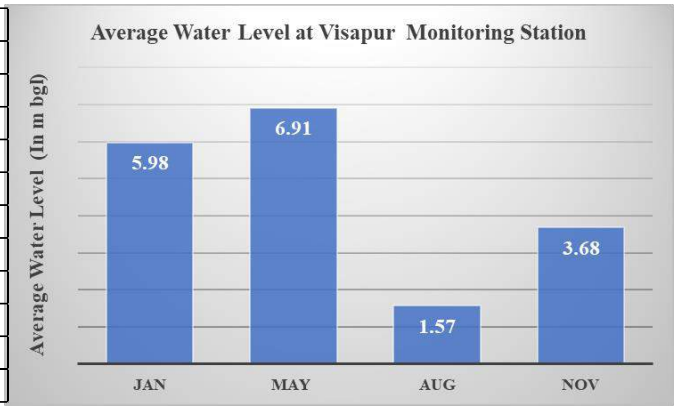


Figure-20: Ground Water Level Trend during Pre and Post Monsoon at Jalgaon Monitoring Station

Table -12: Visapur Monitoring Well Data from 2013 to 2022

Year	Jan	May	Aug	Nov
2013	6.75	6.9	0.5	2.9
2014	5.2	6.5	0.1	4.9
2015	6.35	6.2	2.9	3.6
2016		7.6	2	4
2017	5.9	7.65	1.95	3.3
2018		7	1	
2019	6.5	6.5	2.1	2.8
2020	6.1			3.6
2021	5.95		0.8	4.55
2022	5.1		2.8	3.5
Avg	5.98	6.91	1.57	3.68



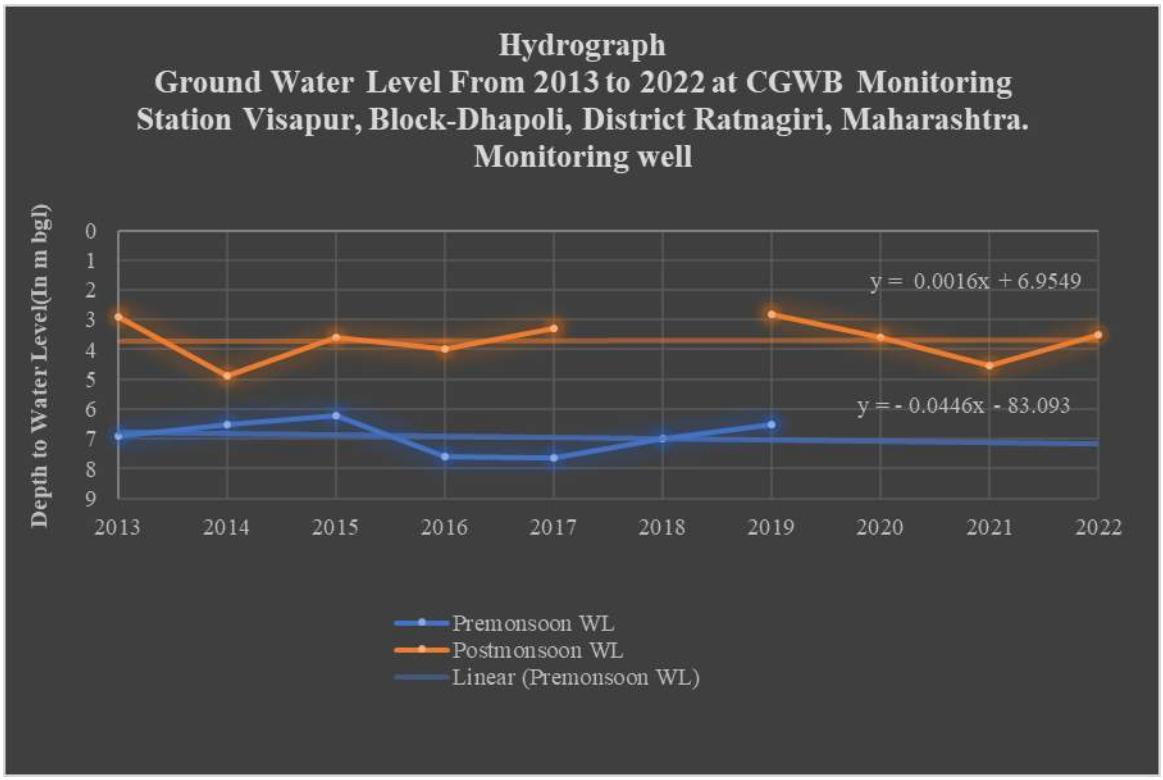


Figure-21: Ground Water Level Trend during Pre and Post Monsoon at Visapur Monitoring Station

Table-13: Abstract of the long-term ground water level trend.

Trends for the Hydrograph (Monitoring Well)	Trend – Rise		Trend - Fall	
	Pre-Monsoon Rate of Rise (m/year)	Post-Monsoon Rate of Rise (m/year)	Pre-Monsoon Rate of Fall (m/year)	Post-Monsoon Rate of Fall (m/year)
Dapoli	0.012	0.031	-	-
Jalgaon	0.066	0.011	-	-
Visapur	-	0.001	0.044	-
Average	**0.039**	**0.014**	**0.044**	**-**

The long-term ground water level trend for the 3 CGWB wells indicates that there is raising trend in 2 season (Pre-monsoon period) and 3 season (post-monsoon period). The falling trend observed in 1 season Pre- Monsoon periods.

The average Rise trend in Pre-monsoon period is 0.039 m/year and post-monsoon 0.014 m/year. The average Fall in the Pre-monsoon period is 0.044 m/year.

The slight dwindling of water levels reported during the pre-monsoon season may perhaps be due to declining rainfall trends and enhancement of groundwater dependency towards domestic and agricultural needs.

The long-term trend in and around the study area clearly indicates that there is no stress in the Groundwater.

Predicted water level declines for affected aquifers

There is no adverse impact on groundwater regime, due to withdrawal of ground water for the purposes of project because whatever ground water is being pumped out from the aquifer through existing dug well for domestic uses, which is being readily replenishable from rainfall and recharge measures adopted in the industry.

3.3.5 Ground water quality

Water quality analysis is one of the important aspects in groundwater studies. The hydro chemical study reveals quality of water that is suitable for drinking, agriculture and industrial purposes. Further, it is possible to understand the change in quality due to rock water interaction or any type of anthropogenic influence. Groundwater often consists of major chemical elements viz Ca^{+2}, Mg^{+2} CI^{-1} $HCO3^{-1}$, F^{-1} and SO_4^{-2}. The chemistry of groundwater plays a significant role in classifying and assessing water quality. Considering the individual and paired ionic concentration, certain indices are proposed to find out the alkali hazards. Residual sodium carbonate (RSC) can be used as a criterion for finding the suitability of irrigation waters. It was observed that the criteria used in the classification of waters for a particular purpose considering the individual concentration may not find its suitability for other purposes and better results can be obtained only by considering the combined chemistry of all the ions rather than individual or paired ionic character. Chemical classification also throws light on the concentration of various predominant cations, anions and their interrelationships. A number of techniques and methods have been developed to interpret the chemical data. Presentation of chemical analysis in graphical form makes understanding of complex groundwater system simpler and quicker. The objective of the present study of ground water in buffer zone is to find out its suitability for drinking and industrial purposes.

To study the quality of ground water total 13 samples are collected from bore well/hand pump and dug well during 9,10 & 11th April 2024 (within core & buffer zone and outside of the buffer zone). Two samples are also collected from surface water source *viz.* Bharja River and Sea Water. The locational details and coordinates of the Groundwater samples collected are shown in **Table-14.** Groundwater samples were analyzed in NABL Accredited laboratory. A groundwater quality reports are given in **Annexure-4.** The water quality maps prepared for Electrical Conductivity concentration shown in ***Figure-22***. Chloride concentration shown in ***Figure-23*** Nitrate (point value) shown in ***Figure-24*** and Fluoride (point value) are shown in ***Figure-25***. The result of analysis of ground water samples are

shown in **Table-15 & 16,** and the result of surface water samples given in **Table-17.**

Table-14: Location of Groundwater and surface water samples.

S. No.	Village	Latitude	Longitude	Source
1	Malvi	17.889167°	73.098611°	Dug well
2	Borthal	17.870642°	73.107893°	Dug well
3	Panchpandri	17.832778°	73.092222°	Dug well
4	Anjarle	17.850278°	73.100000°	Dug well
5	Ambavoli	17.940555°	73.083891°	Bore well
6	Shipole	17.975556°	73.091389°	Dug well
7	Nayane	17.950000°	73.152500°	Dug well
8	Devhare	17.968770°	73.157462°	Dug well
9	Umbershet Mine Pit	17.925000°	73.085278°	Mine Water
10	Dauli	17.894743°	73.160248°	Bore well
11	Virsai	17.907500°	73.173333°	Dug well
12	Gauliwadi	17.897047°	73.189052°	Dug well
13	Rowale	17.913368°	73.102873°	Bore well
14	Nr. Chinchghar vill.	17.941387°	73.127776°	Bharja River
15	Anjarle Coast	17.870647°	73.078020°	Sea Water

Table -15; Results of Chemical analysis of Ground Water and surface water in core and around Buffer Zone

S.NO.	Test Parameters	Unit	(Dug well) Malvi	(Dug well) Borthal	(Dug well) Panchpandri	(Dug well) Anjarle	(Bore well) Ambavoli	(Dug well) Shipole	(Dug well) Nayane
		Coordinates	**17.889167° 73.098611°**	**17.870642° 73.107893°**	**17.832778° 73.092222°**	**17.850278° 73.100000°**	**17.940555° 73.083891°**	**17.975556° 73.091389°**	**17.950000° 73.152500°**
1	pH	-	6.08	6.77	6.44	7.07	6.15	6.64	6.59
2	Turbidity	NTU	0.7	<0.10	6.3	0.2	1.3	0.2	0.3
3	Conductivity	µmhos/cm	222.4	324	860	515	111	227.3	54.17
4	Total Alkalinity	mg/lit	58	144	92	202	40	76	26
5	Total Dissolved solid	mg/lit	70	201	516	272	47.9	134	19
6	Total Hardness as $CaCO_3$	mg/lit	52	114	228	234	32	78	22
7	Calcium as Ca	mg/lit	8.81	40.08	54.5	30.46	5.61	18.43	4
8	Magnesium as Mg	mg/lit	7.29	3.4	22.35	38.39	4.37	7.77	2.91
9	Chlorides as Cl	mg/lit	21.99	18.99	180.94	32.98	17.99	18.99	12.99
10	Sulphates as SO_4	mg/lit	3.21	6.23	43.93	37.68	5.99	8	5.81
11	Nitrate as NO_3	mg/lit	0.05	0.12	16.39	2.87	0.87	12.27	0.3
12	Iron as Fe	mg/lit	0.05	0.05	0.06	0.06	0.13	0.05	0.06
13	Fluoride as F	mg/lit	0.32	0.11	0.22	0.3	0.28	0.52	0.45
14	Sodium as Na	mg/lit	14.2	12	15.6	18.7	21	14	11.8
15	Aluminium as Al	mg/lit	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
16	E. Coil	MPN/100ml	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00

Table- 16 Continued…; Results of Chemical analysis of Ground Water and surface water in and around Buffer Zone

S.NO.	Test Parameters	Unit	(Dug well) Devhare	(Mine Water) Umbershet Mine Pit	(Bore well) Dauli	(Dug well) Virsai	(Dug well) Gauliwadi,	(Bore well) Rovale
		Coordinates	**17.968770° 73.157462°**	**17.925000° 73.085278°**	**17.894743° 73.160248°**	**17.907500° 73.173333°**	**17.897047° 73.189052°**	**17.913368° 73.102873°**
1	pH	-	6.41	6.84	6.31	6.37	6.33	6.75
2	Turbidity	NTU	0.1	0.4	0.7	0.8	1.4	3.5
3	Conductivity	µmhos/cm	135	110.5	74.17	48.67	83	101.3
4	Total Alkalinity	mg/lit	32	16	32	26	38	50
5	Total Dissolved solid	mg/lit	61.3	24	38	25	42	52
6	Total Hardness as $CaCO_3$	mg/lit	32	10	24	16	36	40
7	Calcium as Ca	mg/lit	11.22	3.2	7.21	4.8	8.01	12.02
8	Magnesium as Mg	mg/lit	0.97	0.48	1.45	0.97	3.88	2.43
9	Chlorides as Cl	mg/lit	40	16.99	15.99	13.99	15.99	14.99
10	Sulphates as SO_4	mg/lit	7.02	5.68	4.6	1.77	3.36	4.05
11	Nitrate as NO_3	mg/lit	7.98	2.73	1.36	0.38	0.53	0.61
12	Iron as Fe	mg/lit	0.05	0.06	0.06	<0.05	0.08	0.11
13	Fluoride as F	mg/lit	0.22	0.48	0.28	<0.10	0.66	0.45
14	Sodium as Na	mg/lit	15	16	18	17.5	14.9	12
15	Aluminium as Al	mg/lit	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
16	E. Coil	MPN/100ml	<2.00	17	<2.00	<2.00	<2.00	<2.00

Table 17; The summarized result of Chemical analysis of Ground Water

S. No.	Constituents		Acceptable Limit As per IS 10500:2012 (Amd. No.3 Feb-2021	Minimum	Maximum	Average
1	pH	NA	6.5 -8.5	6.08	7.07	6.519
2	Turbidity	NTU	1	0.1	6.3	1.325
3	Conductivity	mg/lit	2000	48.67	860	220.501
4	Total Alkalinity	mg/lit	200	16	202	64.000
5	Total Dissolved solid	µmhos/cm	500	19	516	115.554
6	Total Hardness as $CaCO_3$	mg/lit	200	10	234	70.615
7	Calcium as Ca	mg/lit	75	3.2	54.5	16.027
8	Magnesium as Mg	mg/lit	30	0.48	38.39	7.435
9	Chlorides as Cl	mg/lit	250	12.99	180.94	32.525
10	Sulphates as SO_4	mg/lit	200	1.77	43.93	10.564
11	Nitrate as NO_3	mg/lit	45	0.05	16.39	3.574
12	Iron as Fe	mg/lit	0.3	0.05	0.13	0.068
13	Fluoride as F	mg/lit	1.0	0.11	0.66	0.358
14	Sodium as Na	mg/lit	200	11.8	21	15.438
15	Aluminum as Al	mg/lit	0.03	<0.003	<0.003	<0.003
16	E. Coil	MPN/100ml		<2.00	17	17

Analytical Result of water quality:

The perusal of chemical analysis results of ground water and surface water samples collected and analyzed as depicted in above tables that water in general is safe as majority of the constituents are within the permissible limit.

From the study of the above table following inferences can be drawn:

pH: pH value of ground water indicates that water is in general a bit alkaline in nature as average pH is > 6.519 (pH=>6.5) in shallow and deep bore wells. The pH values of all analyzed samples ranging from 6.08 to 7.07 remains within the standard norm.

Total Dissolved Solids:

To ascertain the suitability of groundwater for any purposes, it is essential to classify the groundwater depending upon their hydro-chemical properties based on their TDS values. The ground water of the area is fresh water. Most of the groundwater samples are within the maximum permissible limit for drinking as per WHO international standard. TDS concentration varies from 19 to 516 m g/l.

Electrical Conductivity: Most of the groundwater samples are within the maximum permissible limit for drinking as per WHO international standard. EC concentration

varies from 48.6 to 860 EC µS/cm at 25°C. Both Mine lease area falls in 100 to 200 µS/cm EC zone.

Total Hardness: TH is considered as a major character of drinking water. Hardness is defined as the concentrations of calcium and magnesium ions. Ca and Mg are dissolved from most soils and rocks. Total Hardness varies from 10 to 234 mg/l.

Sulphate: Sulphate concentration varies from 1.77 to 43.93 mg/lit ll. The sulphate concentration in the water samples is much less than the acceptable range of 200 mg/l. This could be due to less ingress of irrigation water rich in sulphatic fertilizers and absence of sulphide minerals in appreciable quantities in the host rocks and moreover less air pollution.

Calcium: Calcium concentration varies from 3.2 to 54.5 mg/lit in with an average value of 16.027 mg/lit in bore well, which is under permissible limit.

Magnesium: Magnesium concentration varies from 0.48 to 38.39 mg/lit. The important source of Ca and Mg is ascribed to weathering of Ca and Mg bearing minerals of the rocks.

Chloride: Chloride concentration varies from 12.99 to 180.94 mg/lit. An isochore map is prepared shows that Mine area falls in 15 to 30 mg/l chloride zone.

Nitrate: The concentration of nitrogen in groundwater is derived from the biosphere. Nitrogen is originally fixed from the atmosphere and then mineralized by soil bacteria into ammonium. Under aerobic conditions nitrogen is finally converted into nitrate by nitrifying bacteria. All samples show nitrate concentration within the permissible limit it ranges from 0.05 to 16.39 mg/l**.**

Fluoride: Fluorine forms F^- ions in water which may form strongly soluble complexes with aluminium, beryllium and ferric iron. In the presence of boron, it forms mixed fluoride-hydroxide complexes. In all waters the fluorine content is 0.11 to 0.66 mg/l. The fluorine background value of groundwater of bore well ranges less than 1.0 mg/l, which is not harmful for any purposes.

The physicochemical and biological analysis revealed that all the parameters were well within the prescribed limits of IS: 10500-2012**.** A perusal of concentration of various chemical constituents of water indicate that Ground water is most suitable for all the purposes viz. drinking, domestic and irrigation purposes.

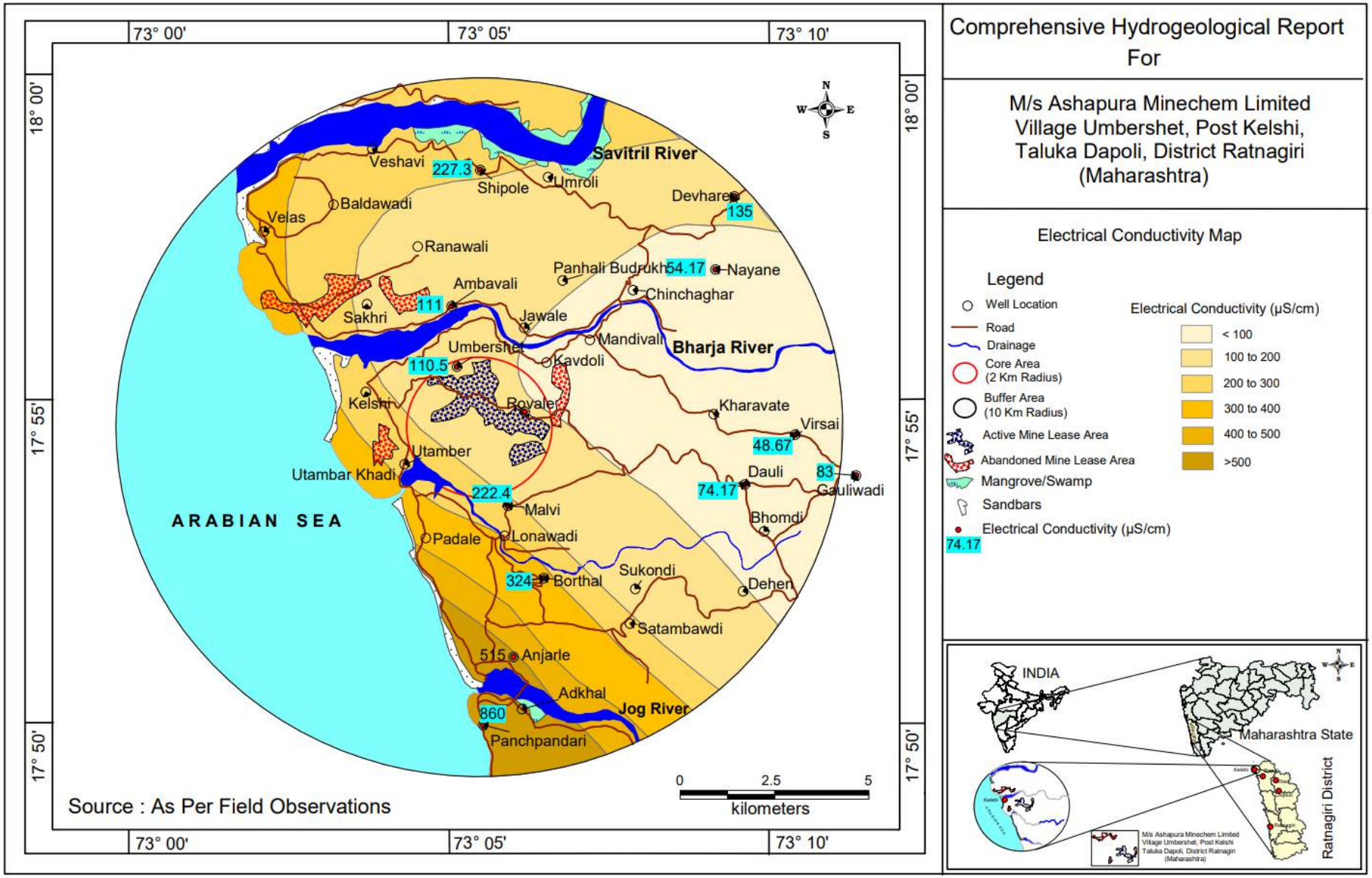


Figure-22: Electrical conductivity map of the Study area

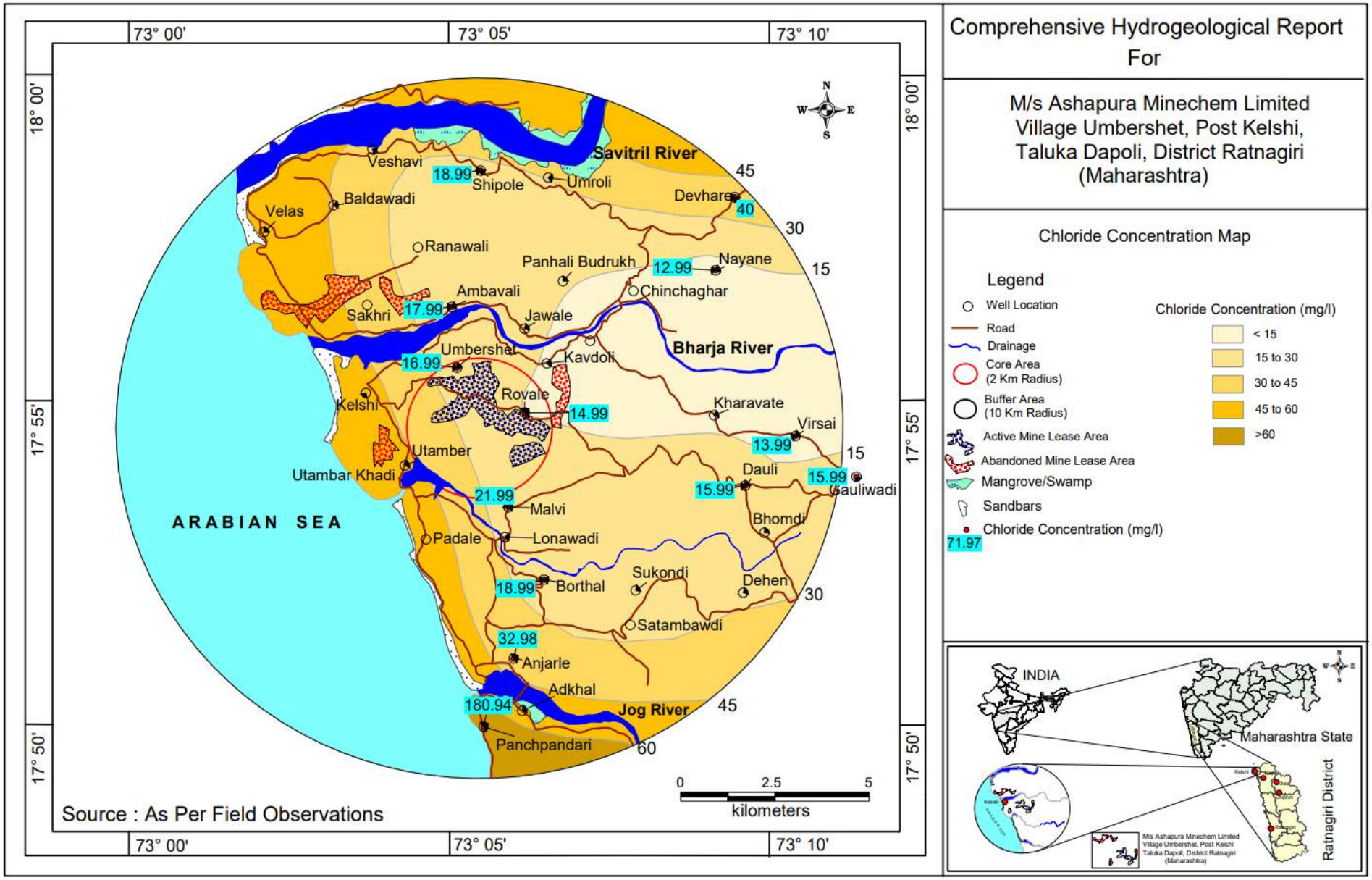


Figure-23: Chloride Concetration map of the Study area

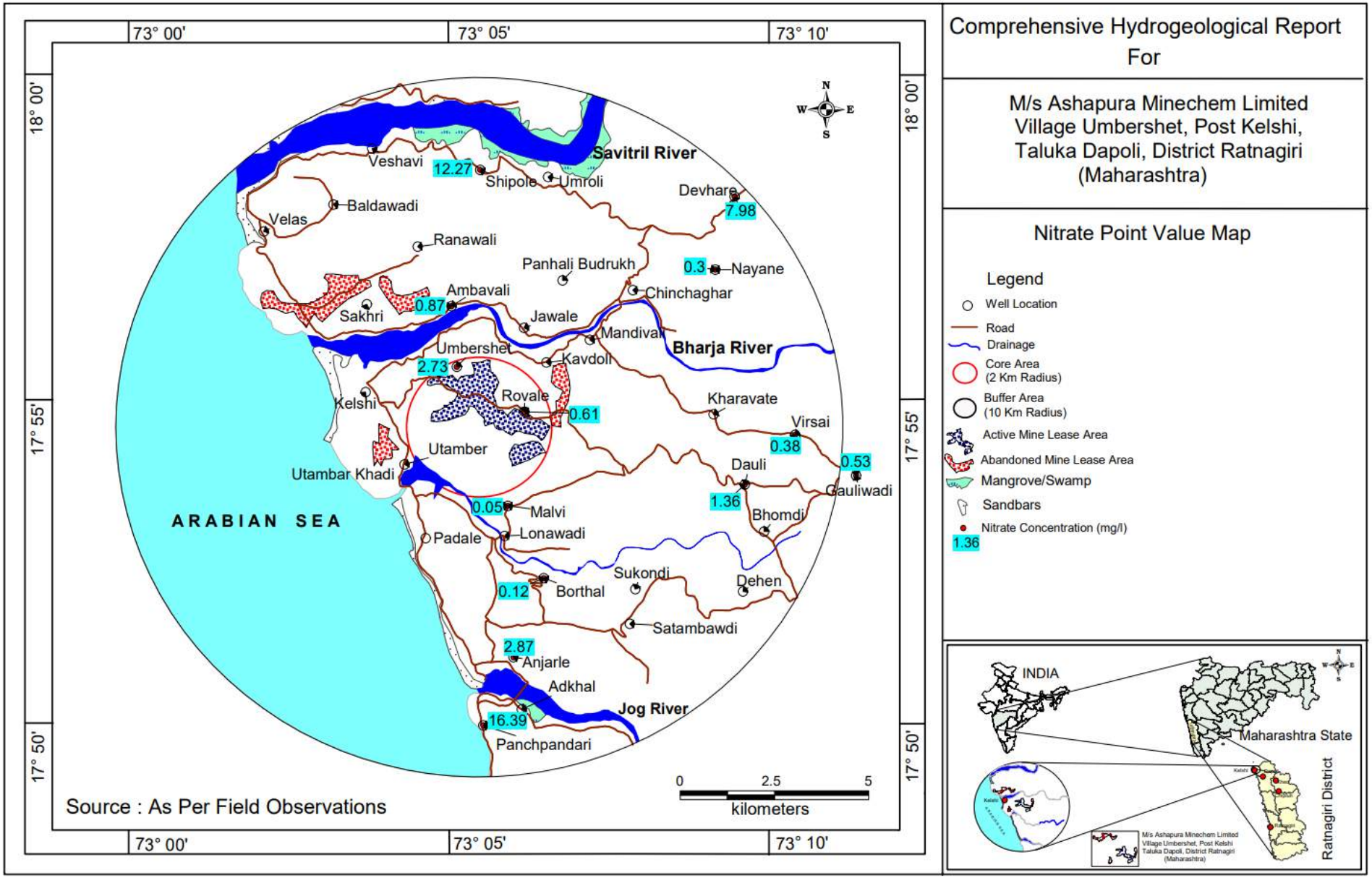


Figure-24: Nitrate Distribution map of the Study area

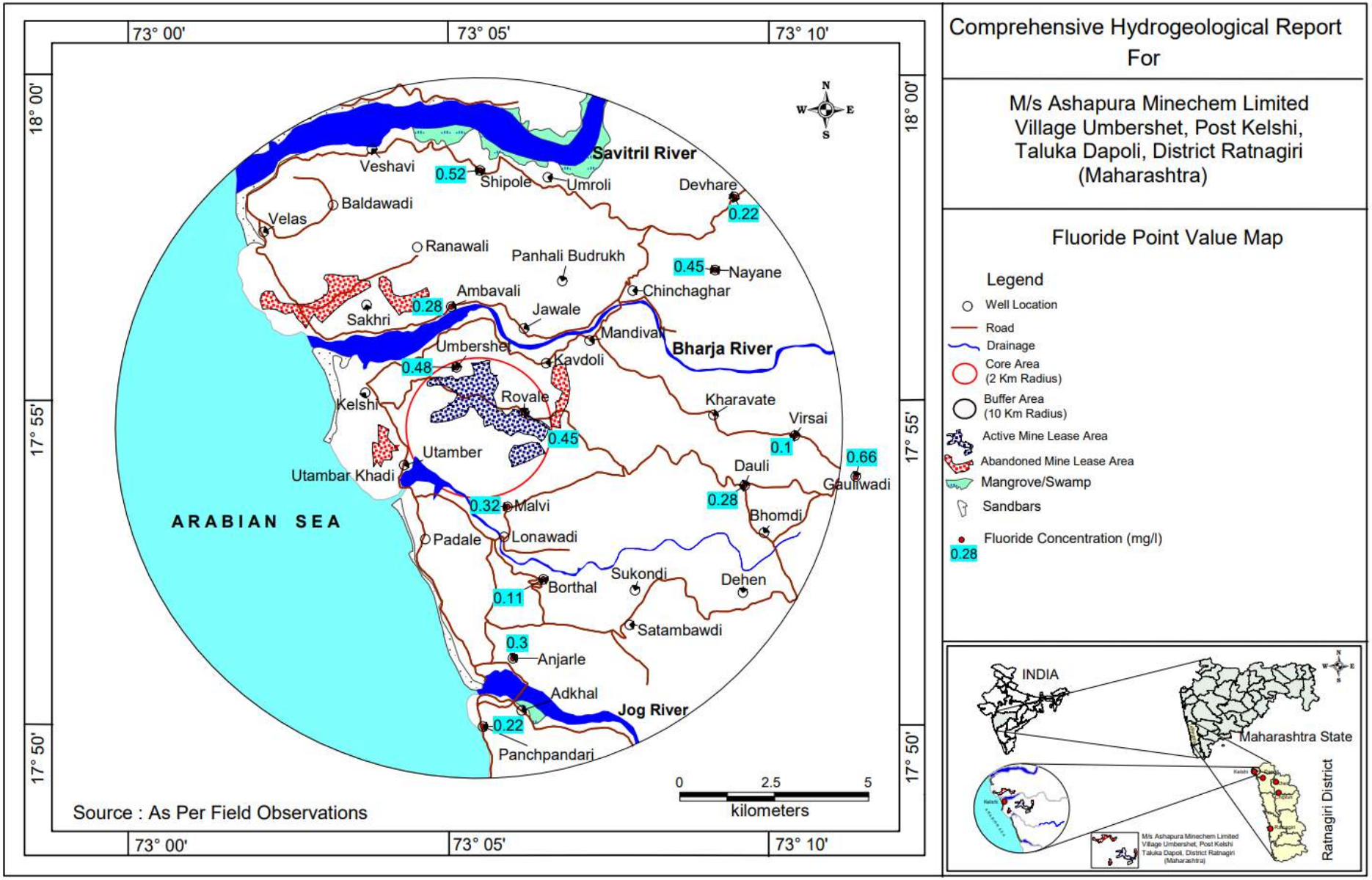


Figure-25: Fluoride Distribution map of the Study area

3.3.6 Water quality of nearby water bodies;

For determining the surface water quality, water samples of nearby water body i.e. from Bharja River and Sea Water were taken for determining the quantity of different parameters. The same is shown in **Table-18** and Water quality reports are enclosed as **Annexure-5**. The physicochemical and biological analysis revealed that all the parameters were well within the prescribed limits of IS: 10500-2012. A perusal of concentration of various chemical constituents of water indicates that surface water is suitable for all the purposes viz. drinking, domestic and irrigation purposes.

Table- 18; Surface Water and Sea Water Quality analysis

S.No.	Test Parameters	Unit	Surface Water	Sea Water
			Bharja River	**Sea Water**
		Coordinates	**17.941387° 73.127776°**	**17.870647° 73.078020°**
1	pH	-	7.38	7.54
2	Turbidity	NTU	0.6	1.8
3	Conductivity	µmhos/cm	3103	77360
4	Total Alkalinity	mg/lit	50	120
5	Total Dissolved solid	mg/lit	1346	39340
6	Total Hardness as $CaCO_3$	mg/lit	304	6900
7	Calcium as Ca	mg/lit	31.26	480.96
8	Magnesium as Mg	mg/lit	54.91	1385.1
9	Chlorides as Cl	mg/lit	714	21243.38
10	Sulphates as SO_4	mg/lit	50.52	81.51
11	Nitrate as NO_3	mg/lit	0.99	1.85
12	Iron as Fe	mg/lit	0.07	0.07
13	Fluoride as F	mg/lit	0.56	0.91
14	Sodium as Na	mg/lit	26	36
15	Aluminium as Al	mg/lit	<0.003	<0.003
16	E. Coil	MPN/100ml	33	70

4.0 APPROVED MINE PLAN

Mine plan/Review of Mine Plan has been approved by IBM, Regional Controller of Mines, Goa, letter no. RMP/MECH-08(MAH)/GOA/19-20 dated 30.07.2020 for proposal period of 2020-21 to 2024-25**.**

Presently mining operations are being carried out by opencast mining method. Machines are used for excavation and loading of mineral. Due to soft nature of mineral explosive is not in use and not prosed. Initial manual sorting of mineral is being done at mine site. From pit face waste material of Bauxite and minor mineral will be loaded to truck, and will be placed near pit face separately. During proposal period, mining will be confined within the ultimate pit limit of 179 m amsl in Umbershet Mine while in Rowale Mine 214 m amsl. Due to undulating topography the surface mine are working as horizontal extension at different elevations varies from 221 to 185 m amsl in Umbershet Mine and in Rowale Mine 250 to 218 m amsl. Mine waste generated along with minor mineral will be carried out for backfilling, simultaneously. Haul road has been extended to the floor of the quarry and benches. The bench height and width will be left for safe movements of machinery. No perennial drain flows within the lease area. The approval of mine plan is enclosed as **Annexure-6.**

5.0 Estimation of Mine Seepage and Advanced Dewatering Plan.

Type of mine: Mine is Open cast.

Elevation of water table at mining area: Depicting water tables in the study area, contours at intervals of 20 m were drawn and presented in pre and post monsoon ground water table map shown in ***Figure-13 & Figure-14****(pl refer earlier para**, ch.-3).* The ground water table generated using the pre and post monsoon data indicates that the Ground water flow towards west from the mine lease area.

The depth to ground water table in the eastern part of core zone from where ground water inflow takes place into Umbershet mine at 180 m amsl in both pre- monsoon period and post monsoon period. Rowale Mine is confined up to 214 m amsl, where, Groundwater table elevation is at 200 m amsl, therefore groundwater could not be intersected in Rowale Bauxite Mine area, as per current proposal period of mining provided by the PP. Tentative Cross-Section of Rowale Mine showing elevation of mine and Groundwater is presented in ***Figure-26***.

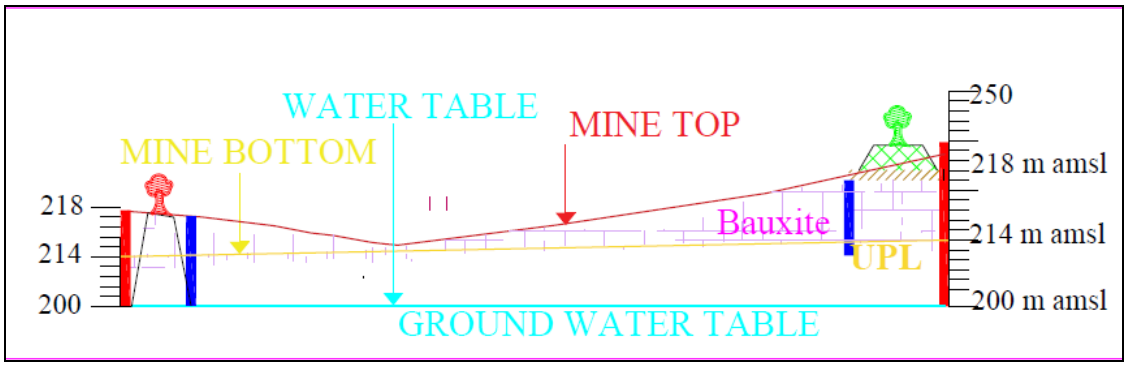


Figure-26: Tentative Cross-Section of Rowale Mine Showing Elevation of Mine and Groundwater Table.

To establish the water table configuration the water table gradient has been estimated from the ground water slope at the Mining Pit area for pre and post monsoon periods are given in **Table-19a and 19b,** respectively. The details of the Hydraulic gradient extracted for two different seasons are as follows

Table-19a; Calculation of hydraulic gradient for Pre-monsoon season:

Details	**Pre-Monsoon**		**Average**
h1 in m	200	160	
h2 in m	180	140	
I (Distance Between h1 and h2) in km	0.3982	0.3328	
Hydraulic Gradient (i) = h1-h2/I m/km	50.22601708	60.09615385	**55.16108546**
Or m/m	**0.050226017**	**0.060096154**	**0.055161085**

Table-19b; Calculation of hydraulic gradient for Post monsoon season:

Details	**Post-Monsoon**		**Average**
h1 in m	200	160	
h2 in m	180	140	
I (Distance Between h1 and h2) in km	0.3351	0.3309	
Hydraulic Gradient (i) = h1-h2/I m/km	59.68367651	60.44122091	**60.06244871**
Or m/m	**0.059683677**	**0.060441221**	**0.060062449**

From the above tables, the average hydraulic gradient has been computed as 0.055161085 m/m and 0.060062449 m/m in pre-monsoon season and post -monsoon seasons, respectively.

Details of Mine pit: In Ashapura Minechem Ltd., open cast mining operation is continued in horizontal extension. Due to undulating topography the surface mine are working as horizontal extension at elevation of 185 m amsl in Umbershet Mine and in Rowale Mine 218 m amsl. The pit wise mine dimensions are given in **Table-20**:

Table-20: Year wise mine dimensions for current five-year period

Year	Calender Year	Period	Opencast Rovale Mine Pit,Working Bench Reduce Level In m amsl		Depth	Perimeter In m	Length~m	Width~m
			Top	Bottom				
1	2020-21	1st Year	250 to 218	246 to 214	4	100 to 300	10 to 80	20 to 90
2	2021-22	2nd Year	250 to 218	246 to 214	4	100 to 300	10 to 80	20 to 90
3	2022-23	3rd Year	250 to 218	246 to 214	4	100 to 300	10 to 80	20 to 90
4	2023-24	4th Year	250 to 218	246 to 214	4	100 to 300	10 to 80	20 to 90
5	2024-25	5th Year	250 to 218	246 to 214	4	100 to 300	10 to 80	20 to 90
Year	Calender Year	Period	Opencast Pit-Umbershet, Working Bench Reduce Level (m amsl)		Depth	Perimeter In m	Length~m	Width~m
			Top	Bottom				
1	2020-21	1st Year	221 to 185	215 to 179	6	100 to 300	30 to 80	50 to 90
2	2021-22	2nd Year	221 to 185	215 to 179	6	100 to 300	30 to 80	50 to 90
3	2022-23	3rd Year	221 to 185	215 to 179	6	100 to 300	30 to 80	50 to 90
4	2023-24	4th Year	221 to 185	215 to 179	6	100 to 300	30 to 80	50 to 90
5	2024-25	5th Year	221 to 185	215 to 179	6	100 to 300	30 to 80	50 to 90

Source: Data of year wise mining proposal provided by the PP.

5.1 Estimation of Mine Seepage

Deposit of Bauxite and laterite are intermix deposit, mineral like laterite, therefore mining is being done for Bauxite mineral. Due to the stratification of formations, the horizontal permeability (KH) is usually many folds higher than the vertical permeability (KV). Thereby, the groundwater velocity along the bedding plane is higher than that across it. During mine development, the Laterite and Bauxite minerals beds existing in the roof of the working bed become the major source for inflow into the mine. The development of Bauxite, the Bauxitic clay in the roof behaves as aquicludes and restricts the connection between the phreatic aquifer and the lower confining aquifers. The aquifer lying only in the immediate vicinity of mine workings get largely drained. However, with the presence of soil cover which are loosely cemented and poorly consolidated and laterite and Bauxite mineral in the shallow aquifer system is the major potential bed in this aquifer system.

With the presence of low permeable formations of clay minerals, the inflow is significantly small in lower aquifer units. In due course, due to partial de-saturation of the aquifer, the inflow reduces and gets stabilized in time.

The probable mine inflow from underneath deposits can be made direct from **Darcy's law** (Eq. 1). Wherein, the groundwater inflow from different mine faces and the individual aquifer units is assessed, owing to the assumptions that flow is laminar and one phase flow into the mining excavation.

Using Darcy's law, one-dimensional inflow may be expressed as:

$$Q = T*I*L \qquad \text{...Eq. 1}$$

Where:

Q = Flow rate (m^3)

B = Aquifer thickness (m)

T = Transmissivity =K*b (m^3/day)

A = Area of the pit (m^3) (i.e., Face length*aquifer thickness)

L = Perimeter/ average width of the cross-sectional area, L (m)

Accordingly, mine seepage has been predicted based on Darcy's equation (eq.1) for the exposure of formations/aquifers of Laterite and Basalt. Different components used in this computation is as follows:

Pumping tests have been conducted in the bore well available in the study area to ascertain aquifer parameters. Average Permeability (K) of 0.50 m/day has been estimated. The same is used for the estimation of ground water seepage into the mine. The saturated aquifer thickness has been taken from the average thickness of weathered material of soft sediments in existing well considered as actual thickness of an aquifer.

Based on the above inputs the ground water seepage in to the mine for the end of 1^{st} year and at the end of the 5^{th} year stage of mining has been estimated for the M/s Ashapura Minechem Ltd., Bauxite Mine (Area-318.146 Ha) and furnished in the **Table-21** & **Table-22.**

Table-21: Year-wise calculation mine seepage from wall of Umbershet Mine pit:

Umbershet Mine												
Umbershet Opencast Mine Pit , Benchwise/year mine seepage												
Year	Calender Year	Period	Top	Bottom	Depth to Water Rl	Perimeter	Saturated Thickness	GW Gradient	Hydraulic Conductivity	Per day Mine Seepage	Working days	Annual Mine Seepage
			m amsl	m amsl	m amsl	In m	In m	(m/m)	(m/day)	In cum		In cum/year
Year 1	2020-21	Pre Monsoon	185	179	180	300	1	0.05516	0.5	8.27	151	1249.40
		Post Monsoon	185	179	180	300	1	0.06006	0.5	9.01	214	1928.00
Year 2	2021-22	Pre Monsoon	185	179	180	300	1	0.05516	0.5	8.27	151	1249.40
		Post Monsoon	185	179	180	300	1	0.06006	0.5	9.01	214	1928.00
Year 3	2022-23	Pre Monsoon	185	179	180	300	1	0.05516	0.5	8.27	151	1249.40
		Post Monsoon	185	179	180	300	1	0.06006	0.5	9.01	214	1928.00
Year 4	2023-24	Pre Monsoon	185	179	180	300	1	0.05516	0.5	8.27	151	1249.40
		Post Monsoon	185	179	180	300	1	0.06006	0.5	9.01	214	1928.00
Year 5	2024-25	Pre Monsoon	185	179	180	300	1	0.05516	0.5	8.27	151	1249.40
		Post Monsoon	185	179	180	300	1	0.06006	0.5	9.01	214	1928.00

Table-22: Year-wise calculation mine seepage from wall of Rowale Mine:

Rovale Mine												
Rowale Opencast Mine Pit , Benchwise/year mine seepage												
Year	Calender Year	Period	Top	Bottom	Depth to Water Rl	Perimeter	Saturated Thickness	GW Gradient	Hydraulic Conductivity	Per day Mine Seepage	Working days	Annual Mine Seepage
			m amsl	m amsl	m amsl	In m	In m	(m/m)	(m/day)	In cum		In cum/year
Year 1	2020-21	Pre Monsoon	218	214	200	300	0	0.05516	0.5	0.00	151	0.00
		Post Monsoon	218	214	200	300	0	0.06006	0.5	0.00	214	0.00
Year 2	2021-22	Pre Monsoon	218	214	200	300	0	0.05516	0.5	0.00	151	0.00
		Post Monsoon	218	214	200	300	0	0.06006	0.5	0.00	214	0.00
Year 3	2022-23	Pre Monsoon	218	214	200	300	0	0.05516	0.5	0.00	151	0.00
		Post Monsoon	218	214	200	300	0	0.06006	0.5	0.00	214	0.00
Year 4	2023-24	Pre Monsoon	218	214	200	300	0	0.05516	0.5	0.00	151	0.00
		Post Monsoon	218	214	200	300	0	0.06006	0.5	0.00	214	0.00
Year 5	2024-25	Pre Monsoon	218	214	200	300	0	0.05516	0.5	0.00	151	0.00
		Post Monsoon	218	214	200	300	0	0.06006	0.5	0.00	214	0.00

5.1.1 Seepage from Bottom of the mine pit:

As per the geophysical survey carried out in the study area, the bottom of the mine is composed of aquiclude (impervious layer) hence the bottom seepage may not encounter into the both mine.

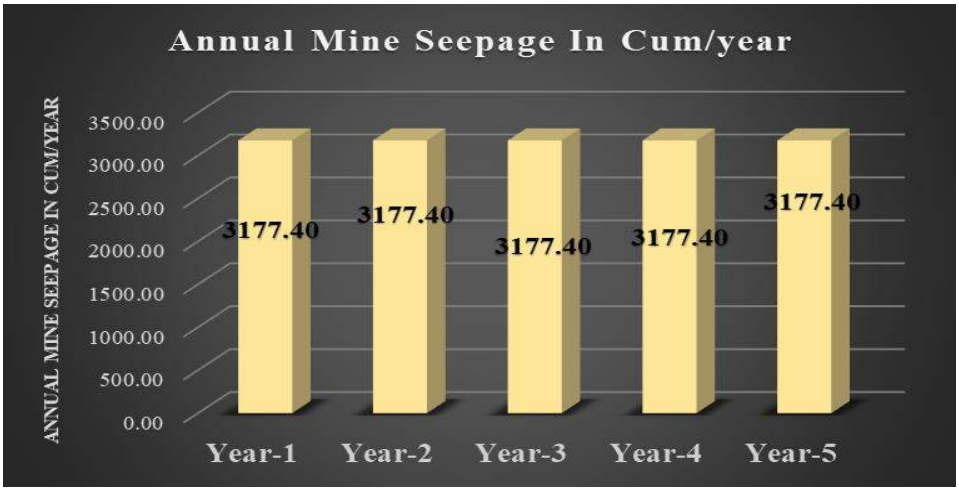
Table -23: ***Seepage from Bottom of the both mine.***

Year	Period	Hydraulic Conductivity (m/day)	Per day mine Seepage (m^3/day)	Annual mine Seepage (m^3/Year)
Years 1 - 5	Pre monsoon	NA	NA	NA
	Post monsoon	NA	NA	NA

5.1.2 Total Mine Seepage: The total mine inflow predictions for different stages of the mine for shown in below Table-24.

Table-24: Total Mine Seepage

Year	Period	Annual Mine Seepage (m3/year) Table 16 + 17)	Average per day
Year 1	**Pre-Monsoon**	**3177.40**	**8.64**
	Post Monsoon		
Year 2	**Pre-Monsoon**	**3177.40**	**8.64**
	Post Monsoon		
Year 3	**Pre-Monsoon**	**3177.40**	**8.64**
	Post Monsoon		
Year 4	**Pre-Monsoon**	**3177.40**	**8.64**
	Post Monsoon		
Year 5	**Pre-Monsoon**	**3177.40**	**8.64**
	Post Monsoon		



5.2 Estimation of Rainwater Quantum Dewatered

In Ashapura Minechem Ltd operating Two mine area viz. a). Umbersht Bauxite Mine, b). Rowale Bauxite Mine. In Umbershet lease, mine operation is carried out in the form of pit up to maximum 6 m bgl, whereas, in Rowale, mining is carried out on steeply sloping hill, hence, no rainwater is being collected in the Rowale Mining site.

The rain water storage in to the Umbershet Bauxite mine pit is estimated. While mine pit is being excavated, protection arrangements like garland drain in mine periphery are made for ease the operation. Normally, the dumps are used for the protection arrangement and green belt are developed to reduce the erosion and to avoid dust pollution. The area of mine and its year wise dimensions (length, width and depths) is provided by the project proponent. Based on the above the mine pit the storage volume has been estimated. It is evident that the rainfall collection in the mine pit contributes considerably in monsoon period while it may be low in non-monsoon period. The monthly storage collection based normal rainfall has been estimated and the same is presented in **Table-25.**

Table-25: Estimation of monthly rain water collection in Umbershet Bauxite Mine Pit.

Estimation of Monthly Mine Pit Rainwater Direct collection			
Name of Mine	**Ashapura Minechem Ltd**	**Co-efficient**	**Total Rain water Quantum (In cum/Year)**
Area under Mine Pit Umbershet Mine m²	**36000**	**0.8**	**44880.00**
Month	**Monthly Rainfall (mm)**	**Month wise Evaporation (In mm)**	**Estimated Rain Water Quantum in cum/month**
January	0.3	7.27	0.00
February	0.1	7.34	0.00
March	0.3	23.99	0.00
April	2.1	34.43	30.24
May	43.8	123.52	630.72
June	869.5	113.24	12520.80
July	972.5	103.66	14004.00
August	723.3	105.93	10415.52
September	364.9	44.01	5254.56
October	123.6	26.53	1779.84
November	17.0	21.27	244.80
December	0.8	8.47	0.0
Total	**3118.20**	**619.66**	**87949.44**
Rainwater Quantum Accumulation = 87949 m³/annum (241 m³/day)			

The total estimated rain water quantum is **87949** m^3/annum and 241 m^3/day. The accumulated groundwater seepage estimated for conceptual stage plan is calculated as 9.0 kL/day (**3177** m^3/annum). All the rain water and mine seepage are accumulated in mine pit. **No dewatering is being done to extract bauxite ore, as reported by the PP**. In this connection, copy of letter issued by project proponent (PP) which is enclosed as **Annexure-7.**

5.3 Advanced Dewatering Plan in case of Coal/Lignite Mines:

Advanced Dewatering Plan is not applicable in this case, because the project is for Mining of Bauxite mineral. No dewatering is being done to extract Bauxite ore, the Bauxite ore deposits on the plateau are of blanket type and mostly covered with laterite capping thickness varies from 2 to 5 m bgl. The accumulated seepage in mine pits as remains as it is.

Details of the tube wells/ borewells:

M/s Ashapura Minechem Ltd. Bauxite Mine, NOC was granted by CGWA vide NOC No. CGWA/NOC/MIN/REN/2/2022/7161 valid from: 08/12/2021, valid up to: 07/12/2023 for one existing dug well. The firm has only one existing dug well fitted with digital water flow meter which is under operational condition to meet the demand of drinking & domestic for mine workmen, dust suppression on haul road and green belt area development in the project area. The details of the dug well is given below in **Table-26.**

Table-26: Details of Existing bore well/dug well.

S. N	Borewell/ Dug well, /Location	Year of Construction	Geographic Coordinates	Depth In m	Diameter In m	Discharge (m^3/hr)	Operational Hrs / day	Horse Power / Fitted with Flow meter	Litholog (m bgl)
1	DW-1/ at Ashapura Shidhivinayak Temple	2010	Lat.; 17.921554° Long.: 73.063245°	7	3	8	12	7.5 / Yes	0-3 m: soil, 3 to 6: laterite with bauxite and clay, 6 to 7: Basalt massive.

Photograph of Existing Dug well Fitted with Digital Water Flow Meter

5.4 GROUND WATER MODELLING:

As per the guidelines issued on 24-09-2020 and subsequent amendment for ground water withdrawal, Ground water modelling is not required in this case because the proposed dewatering quantum is < 500 m^3/day.

6.0 MINE WATER MANAGEMENT

6.1 Impact of Mine Dewatering/ Abstraction and Mitigation Measures

All the rain water and mine seepage are accumulated in mine pit. No dewatering is being done to extract bauxite ore, as reported by the PP.

The groundwater seepage is accumulated in working mine pit and collected Rainwater quantum into the mine pit is being stored in lower bench of mine pit within the lease area to augment the groundwater resources, no dewatering is being done. Groundwater 95 m^3/day from existing dug well is being used for dust suppression, green belt development and drinking & domestic usage for mine workmen.

6.2 Impact on the Ground Water Regime:

The impact on the groundwater regime in and around the project area has been assessed by studying the current stage of groundwater development in the area and the impact of the proposed drawl on it, impact on ground water level in both depth and extent, likely impacts of GW withdrawal on surrounding area in next five years period on the water requirement of the people residing in the surrounding area.

(A) Impact on the Stage of Ground Water Development

Government Agency (Central Ground Water Board, Govt. of India) has computed block-wise ground water resources for all the district of Maharashtra state. The project area falls in the Ratnagiri (Dapoli) block in of Ratnagiri district. As on 2022-23, the Annual extractable ground water resources in the Ratnagiri (Dapoli) block are 3223.7 ham. The ground water extraction from all uses is 847.43 ham. Net ground water available for future irrigation use is 2376.27 ham. The stage of ground water extraction is 26.29 % and falls in the ‘Safe’ category. Dynamic ground Water Resources of the buffer zone is estimated and given in **Table-27.**

Table -27: Dynamic Ground Water Resources of Ratnagiri (Dapoli) block, District Ratnagiri . (Source.www. Ingress) as on 2022-23

Block/ Buffer Zone	Annual Extractable Ground Water Resources	Current Annual Ground Water for irrigation Extraction for Irrigation	Current Annual Ground Water Extraction for Domestic	Current Annual Ground Water Extraction Industrial Water Supply	Existing Gross Ground Water Draft for All uses	Allocation for domestic use supply as on 2025	Net Groundwater Availability for future irrigation development	Stage of Groundwater Extraction (%)	Category
	In Ham								
Block	3,223.7	725.68	121.76	0	847.43	121.77	2,376.27	26.29	Safe

The depth to water level in Piezometer well (from 2021 to 2023) at project area shows the rise in water level of 0.028 m in 2021, 0.078 m in 2022, and 0.16 m in 2023. The water level of Piezometer well is presented in below **Table-28**. Histogram of water level in Piezometer well of project area is shown in ***Figure-27.***

Table-28: Depth to water level data in Piezometer well.

Month	2021	2022	2023
January	10	11	14
February	12	12.4	12
March	12	13.1	14
April	9	9	11
May	8	10	13
June	10	10	10
July	11	8	12
August	11	12	11
September	10	11	10
October	11	10	11
November	12	12	12
December	10	10	12.5

Note: Underlined is the missing data, filled based on interpolation.

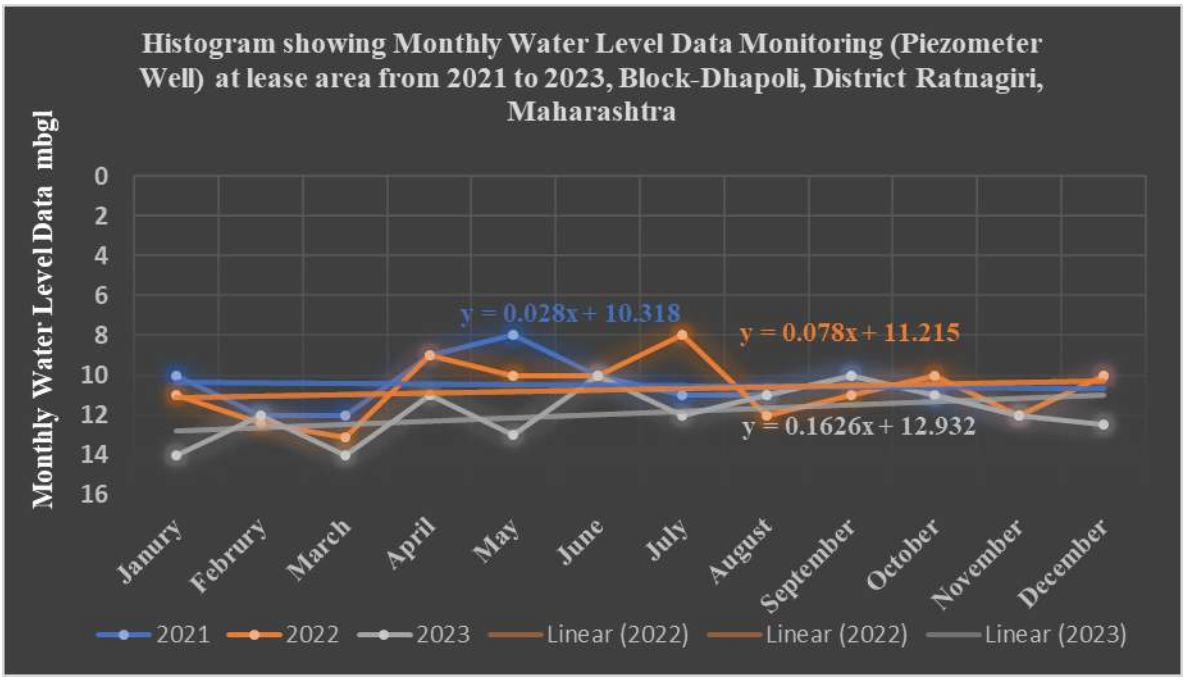


Figure-27: Histogram of Month wise(period 2021 to 2023) Water Level at Piezometer well fitted with Digital Water Level Recorder

Photograph of Piezometer well fitted with Digital Water Level Recorder (DWLR)

6.3 Impact of mining on surface water:

Total area of mining lease block of 318.146 hectares will be opened up for mining. As such there is no water course/nala in the lease area. The Surface water bodies in the study area mainly Bharja River and Savitri River. Arabian Sea located in west part of the buffer

zone. The water from Bharja River and Savitri River is used for irrigation purpose. The result of surface water analysis reveals that the quality of surface water samples is found to be within the permissible limit.

Following control measures have been observed within lease areas.

- Peripheral garland drains and catch drains has been developed beyond mining area to avoid surface run-off. Dumps have been provided with garland drains.
- Cleaning of Garland drain has been done on regular basis to control the soil erosion as well to prevent siltation into nalla and surrounding agricultural land.
- Peripheral barrier is 7.5 m width is left all around the mining lease area to, this also prevents run-off of muddy water from the mines. With the afforestation programs taken-up.
- Bunds have been provided to remove the suspended solids. Cleaning of drains has been observed which help to arrest the siltation.
- Toilet facility has been provided near to the office.

As per the conceptual mine plan, most of the land excavated during mining activity would be reclaimed by backfilling. The backfilling will be done on a regular basis and will continue throughout the mine life to back backfill the mined-out area as much as can be reclaimed. The remaining excavated area shall be developed as a water reservoir which will serve as recharge pit.

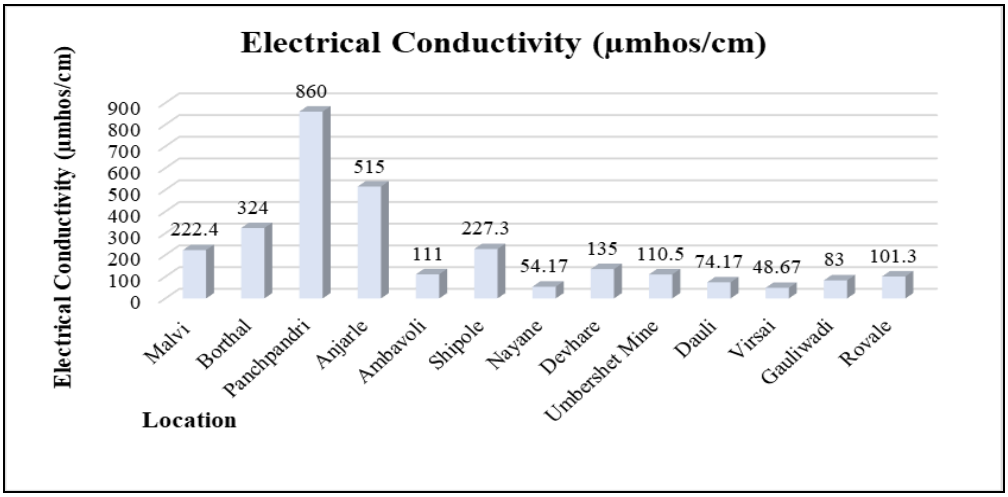
It is therefore apparent that there will be hardly any impact of mining on the surface water regime.

6.4 Impact on Water Quality

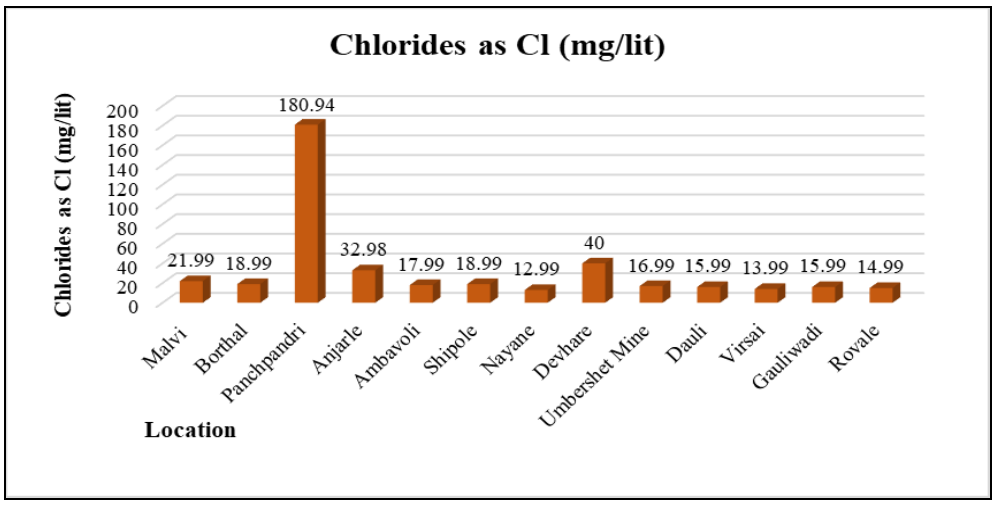
The electrical conductivity of dug well existed in the mining area and mine pit is 110.5 µmhos/cm. The lower concentration of the electrical conductivity shows that Bauxite and Laterite minerals and overburden do not contain any harmful constituents. Hence ground water quality could not leach down to water table; there is no possibility of any impact on water quality. No adverse impact in the Groundwater and Surface water quality due to mining. It is observed, the physical and chemical parameters of the ground water of the region in all the sites from which sample were collected are within the limits specified in IS 10500:2012 and can be used for domestic and other purposes.

A perusal of **Table-15, 16 and 17** ***(pl refer earlier para, Ch. 3.3.5)*** showing results of chemical analysis of ground water samples collected and analyzed reveal that ground water in general is potable and majority of the constituents are within acceptable limits,

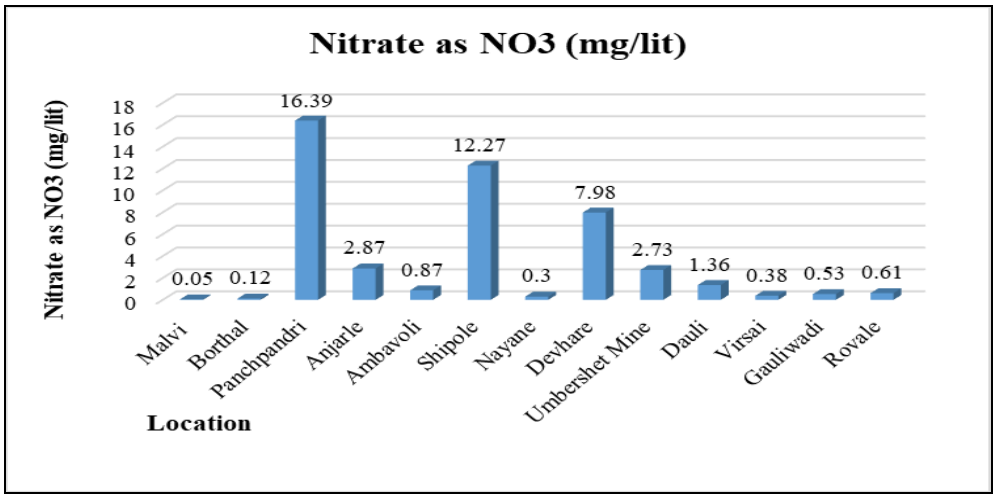
where few are well within the permissible limit. So, it is concluded that ground water is perfectly suitable for drinking and industrial purposes. It is observed that there is no adverse impact on groundwater regime, in terms of quality due to withdrawal of ground water for the purposes of project. The firm is also recycling and reusing the water and maintaining zero discharge and practices to avoid deteriorating of quality of ground water.



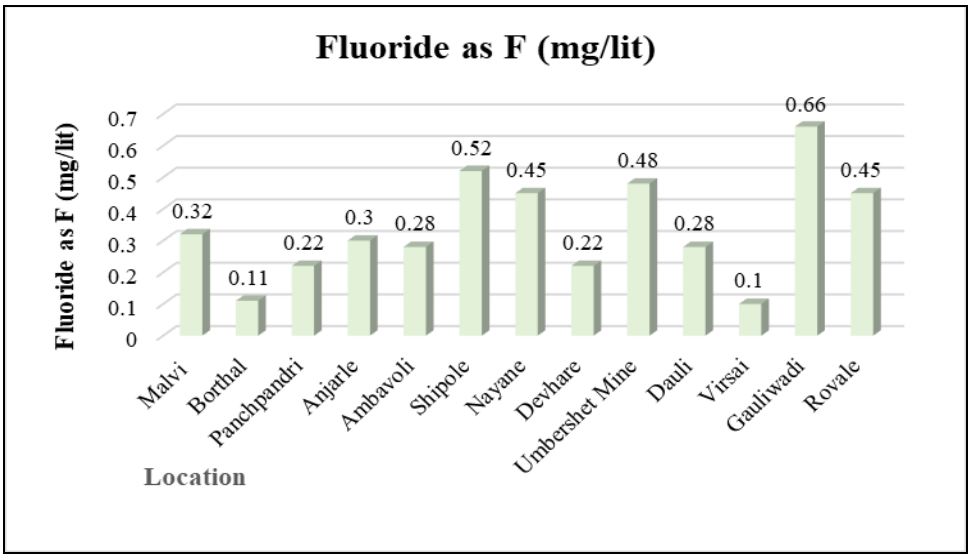
Histogram showing Water Quality of EC concentration in the Study area



Histogram showing Water Quality of Chloride Concentration in the Study area



Histogram showing Water Quality Nitrate Concentration in the Study area



Histogram showing Water Quality of Fluoride Concentration in the Study area

Measures to maintain water quality.

- The soil and over burden may be the source of water pollution. The over burden may be systematically compacted and stacked with proper slope so that there will not be any adverse environmental impact on ground water.
- The quality of surface water is good as the rocks are mostly consolidated sediments having thin soil cover. The rainfall being moderate and having adequate drainage.
- The water quality of buffer zone is potable and all the chemical constituents are within permissible limits. Efforts will be made to maintain the present status of quality.
- Dumps, soil heaps and other hard wastes will have proper bunds surrounding the

periphery. The water will be delivered to peripheral drain / diverted drain after removing suspended matter.

- Ground water quality will be periodically monitored. Monitoring water quality is being done on quarterly basis in a year.
- The water quality is potable and all the chemical constituents are within permissible limits.
- Efforts will be made to maintain the present status of quality.
- Wastewater disposal from canteen and toilets/ washrooms shall create adverse impact on the surface water and ground water resource. However, the volume of such wastewater is less.
- Wastewater from toilets and washrooms will be taken to septic tank for disposal.
- By adopting the all-mitigation measures prescribed as above, the overall impact on ground water and surface water and its quality will be negligible.

6.5 Mitigation Measures

The mitigation measure is discussed in the following sub section.

6.5.1 Rain Water Harvesting

The firm has adopted groundwater recharge measures and rainwater harvesting, in the mining lease area utilizing abandoned mining pit and maintaining the groundwater balance in the area for positive impact on the groundwater regime in the area. As mention above there is no impact on groundwater resources and its quality due to project however, the area falls under safe category as per CGWA. By adopting the all mitigation measures prescribed as above, the overall impact on ground water and surface water and its quality will be negligible.

Availability of Rainwater

The water for harvesting in the project area is the available rainfall runoff generated from the project area and is the most important factor to plan the rainwater harvesting. The rainwater runoff available for harvesting and recharge to ground water depends on the rainfall in the area and the runoff coefficient of the surface on which the rain falls. The main surfaces in the project area are roof top area, road/paved area, green belt and open area. The long term annual normal rainfall at Ratnagiri district is 3137.20 mm (3.1372 m). The Runoff coefficient for the Roof top area is considered as 85%, Road & Paved area as

65%, Green belt area as 15% and for open and unpaved area is considered as 20% as per CGWA norms and the runoff generated is quantified.

The details of various types of surfaces and quantity of runoff generated due to rainfall are given below.

Table-29: Rain water potential of the project area.

S. N	Particulars	Umbershet Mine Area m^2 (A)	Rowale Mine Area m^2 (B)	Total Area (m^2) (A+B)	Run off coefficient	Rain fall (m)	Rain water potential (m^3)
1	Green belt	35500	66900	102400	0.15	3.1372	50952.19
2	Open land	942819	2101050	3043869	0.20	3.1372	1909845.16
2	Road area	20200	14900	35100	0.65	3.1372	71575.21
3	Roof top area	100	0	100	0.85	3.1372	266.66
	Total	998619	2182850	**3181469**	-	-	**21047042.85**

Rain water harvesting potential of project area is 21047042.85 m^3 or 21.05 MCM.

Rain Water Harvesting Implemented for Ground Water Recharge

At present one abandoned mine pit is utilized as water conservation tank, expected recharge is 2179 m^3/year.

Recharge Computation: There is one abandoned mine pit located at Umbershet lease area, which act as recharge structure. This old mine pit received water from dewatering from working mine pit as well as rain water. The details of recharge computation (as per GEC-2015 of CGWB) as follows.

Geo-referenced locational details of Recharge Pit

Point 'A'	Point 'B'	Point 'C'	Point 'D'
Lat.: 17.921080° Long.: 73.089332°	Lat.: 17.920231° Long.: 73.089403°	Lat.: 17.920776° Long.: 73.089729°	Lat.: 17.920720° Long.: 73.088908°

Details of storage capacity in recharge pit and assessment of recharge;

S. No.	Name of recharge structure	Area In m^2	Depth (m)	Av. water column	Storage capacity (m^3)	Rainfall infiltration factor for laterite	Recharge m^3/year
1	Water Conservation mine pit	7150	6	3.81	27241.5	0.08	2179.32

The total recharge is calculated as 2179 m^3/annum.

Photograph of Rain Water Harvesting Pit

6.5.2: Mine water treatment and wastewater management:

All the rain water and mine seepage are accumulated in mine pit. No dewatering is being done to extract bauxite ore, as reported by the PP. The groundwater seepage is accumulated in working mine pit and collected Rainwater quantum into the mine pit is being stored in lower bench of mine pit within the lease area to augment the groundwater resources, no dewatering is being done. Groundwater 95 m^3/day (28500 m^3/year) from existing dug well is being used for dust suppression, green belt development and for domestic usage. Copy of letter from PP is enclosed as Annexure-7.

Flow chart is given in ***Figure -28***. Water demand as per NBC norms 2016 is calculated in **Table -30** and water demand for green belt area is furnished in **Table-31.**

Figure Flow Chart of Water activity; (<u>All figures in m^3/day</u>)

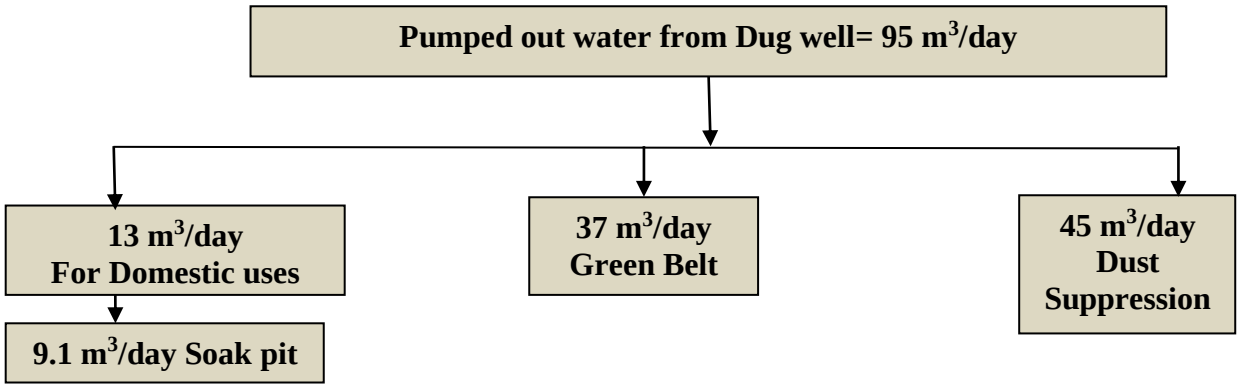


Figure -28: Flow Chart of Water activity

Table-30: Domestic water demand calculation as per NBC norms 2016:

Area of use	Occupants	Rate of water demand (lpcd)	Total Water Requirement for Domestic uses		
			In liters per day	In lcubic meters per day	In Cubic liter per year
Residential staff	70	135	9450	9.4	3431
Daily Staff & workers	80	45	3600	3.6	1314
Total	150		13050	13	4745

Table-31: Calculation of water demand for Green Belt Development:

Plantation ; Source: Groundwater from Dug well.		
Area under plantation	Hectare	10.24
Water requirement per Ha in peak	kL/day	3.61
Total water requirement peak	kL/day	**37**

7.0 Saline Water Disposal Strategies

The mine is not used saline water. Hence, the disposal of saline water does not arise.

8.0 Any other details pertaining to the project: No

9.0 Summary and Conclusion

- M/s Ashapura Minechem Limited (AML) are operating open cast Bauxite Mines with the name of project: **Velas Sakhri Umbershet Rowale Kavdoli and Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt in village Umbershet, Post Kelshi, Taluka Dapoli, District Ratnagiri, Maharashtra**. The project is for Mining of Bauxite Mineral, lease area of 318.146 Ha with expanded capacity of 500000 tonne (For Laterite

and Bauxite). The capacity shall be achieved through open cast method of mining. Central Ground Water Authority (CGWA) was granted the permission vide NOC No. CGWA/NOC/MIN/REN/2/2022/7161 valid from: 08/12/2021, valid up to: 07/12/2023.

- The total aerial extent of the study area covering 10 Km radius from the Mine site boundary is 314 Sq.km. Primarily, 10 Km radius from the Mine site forms part of sea (about 28.5 %). The second major land use is Plantation, which covers 28.4%.
- The terrain elevation (Topography) is derived from the NRSA data. The study area (10 km radius from the lease boundary) elevation ranges from 350 m in southeastern, north central and east central part to 01 m in western part of study area. The north central, southeastern, east-central and eastern of the study area comprising hilly terrain with several ridges and plateaus have elevation in range of 350 to 50 m amsl. The west, southwest-central & northeast part are the level plain with gentle undulating terrain have elevation in range of 50 to 01 m amsl.
- The lease area is a part of hilly topography. In Rowale Bauxite Mine, the highest elevation is of 250 m amsl in the eastern part of the hillock and lowest one is of 218 m amsl, while in Umbershet Bauxite Mine the highest elevation is of 221 m amsl in the NE part of the hillock and the lowest one is of 185 m amsl.
- The land forms / geomorphic units and structures occurring in the study area are mapped. The geomorphology and structures of the area plays the vital role in identifying the ground water potential zones. The outstanding feature in the relief of the study area is its highly uneven nature and very narrow riverine plains that fringe the coastline. About 45 % of the study area is hilly. On the east and southeast this consists of the steep and forbidding scarp of the main Sahyadris. In the center are traverses chains of small and elevated hills, which project from the main ranges, develop higher elevation in the middle portion. These are separated from each other by undulating plateaus having area gradually increasing westward towards the coast. The mining lease area lies on the pediment, which is gradually sloping towards northwest in Umbershet Bauxite Mine and towards southwest in Rowale Mine.
- Savitri River, Jog River and Bharja River are westerly flowing rivers and debauching into the Arabian Sea. Savitri River lies in northern part of buffer zone with the flow direction towards west. Bharja River in the north center part and Jog River in southern part of buffer zone. The drainage pattern in the study area is dendritic to sub dendritic. Beside these rivers, Utamber creek is originated from southeastern upper plateau at an

altitude of about 250 m amsl. Utamber creek is about 3.2 km long and flows west into the Arabian sea.

- No protected wetlands/Ramsar sites/NLCP lake or any important wetland is located inside the buffer zone of this project. The normal rainfall of Ratnagiri district is 3137.20 mm.
- Geologically, the study area is covered with Basaltic flows of Deccan Basalts lavas of Upper Cretaceous to Paleogene age. The plateau tops along with coast are covered by Laterite. Quaternary formations comprising clay, silt cover the laterite and basalts at few places along the coast. The Deccan Basalts of the study area has been grouped under the Sahyadri Group and is divisible into two formations. The Diveghat Formation is confined to eastern half of the study area up to Panchpandri in South. Whereas, Purandargarh Formation is observed at 300 to 350 m amsl. A near horizontal disposition of the basalt flows along the continental divide is significant. Western part of the study area belongs to Arabian Sea.
- Structurally the area is disturbed as an evident lineament observed in the eastern part of the study area trending N-S direction. Laterite spread covering the Deccan Traps are noticed in vast areas of the study. Bauxite deposits on the plateaux are of blanket type and mostly covered with laterite capping.
- Resistivity value recorded near mine office. The laterite thickness is recorded upto 18.8 m depth, then get high resistivity values between 18.8 to 73.3 m depth because massive basalt formation in Rawale Mine and the soil, laterite thickness is upto 41 m bgl, the high resistivity value recorded between surface to 41 m bgl shows that is massive form of laterite along with bauxite and bauxitic clay is encountered, then get low resistivity values between 41 to 60 m bgl due to vesicular basalt formation in Umbershet Mine. The laterite capping contains Bauxite zones with clays at the base of the laterite. The Deccan lava flows which are generally massive.
- The area is also characterized by the presence of laterites which occur as capping over Basalt formations. Laterite occurs in the north, south and eastern part of the study area particularly project area as capping over Basalt rock formation it plays only minor role in hydrogeological set up of area. Ground water in general occurs under unconfined, semi confined & confined conditions. The fracture and joints are wide near surface or just below the weathered mantle. Intense weathering in basalt and mineralization of Bauxite results in production of impervious clayey matrix. Development of minor

lineament is a witness of low degree tectonic deformations, which are more or less responsible for deep seated fracture systems.

- The Transmissivity of aquifer was computed as average 1.51 m^2/day.
- In general, the ground water movement is towards West i.e., towards Arabian sea. In area of low permeability, the water table contours are closely spaced indicating steep gradient. A maximum and minimum groundwater table (April-2024) are 219.63 m amsl and 1.25 m amsl, indicating highly undulating terrain. Surface water divides on central part represents deep water levels. The average hydraulic gradient near mine is 0.055161085 m/m during pre-monsoon and 0.06006244871 m/m during post moon.
- The pre monsoon depth to ground water level depict that relatively deepest of ground water level zone of 10 to 30 m falls in the central, middle- east and southeast part of the study whereas shallow ground water level zone of 2 to 10 m bgl occupies in the south, northern and eastern part of the study area.
- The post-monsoon depth to ground water level zone of 10 to 25 m falls in central, middle east and southeast part of the study. The shallow ground water level zone of 2 to 10 m occupies in south, northern and east part of the study area.
- Pre (2024) and post monsoon (2023) water levels were considered for evaluation of seasonal fluctuation in water level. Fluctuation in water level varies from < 2 to 4 m. which indicates that the aquifer of the study area has moderate recharge potential. The Core zone falls in 2 to 4 m fluctuation zone.
- The project area falls in the Ratnagiri (Dapoli) block in of Ratnagiri district. As on 2022-23, the Annual extractable ground water resources in the Ratnagiri (Dapoli) block are 3223.7 ham. The ground water extraction from all uses is 847.43 ham. Net ground water available for future irrigation use is 2376.27 ham. The stage of ground water extraction is 26.29 % and falls in the 'Safe' category.
- The estimated seepage using TIL formula as per SOP of CGWA. The groundwater table in the eastern part of core zone from where ground water inflow takes place into the Umbershet Bauxite Mine pit in 180 m amsl at pre and post monsoon period. Permeability (K) of 0.50 m/day has been estimated. In Rowale Bauxite Mine carried out up to 214 m amsl, where, Groundwater table elevation is at 200 m amsl, therefore groundwater could not be intersected in Rowale Bauxite Mine area.
- The maximum mine seepage at Umbershet Bauxite Mine is calculated as 9 m^3/day (3177 m^3/annum). The groundwater seepage is accumulated in working mine pit and collected

Rainwater quantum into the mine pit is being stored in lower bench of mine pit within the lease area to augment the groundwater resources, **no dewatering is being done**. Groundwater 95 m^3/day (28500 m^3/year) from existing dug well is being used for dust suppression (45 m^3/day), green belt development (37 m^3/day) and 13 m^3/day for domestic usage.

- The depth to water level in Piezometer well (from 2021 to 2023) at project area shows the rise in water level of 0.028 m in 2021, 0.078 m in 2022, and 0.16 m in 2023.
- Surface drainage will not be get affected as there is no stream passing through lease area.
- The electrical conductivity in the Umbershet Mine area is 110.5 µmhos/cm. The lower concentration of the electrical conductivity shows that Bauxite and Laterite minerals and overburden do not contain any harmful constituents. Hence ground water quality could not leach down to water table; there is no possibility of any impact on water quality. No adverse impact in the Groundwater and Surface water quality. It is observed, the physical and chemical parameters of the ground water of the region in all the sites from which sample were collected are within the limits specified in IS 10500:2012 and can be used for domestic and other purposes.
- There is one abandoned mine pit located at Umbershet lease area, which act as recharge structure inside the project area for augmenting groundwater resources in the area.
- It can be concluded that the implementation of the mitigation measures, the project activities would have no adverse impacts on the groundwater regime. Therefore, the present project will be eco balanced and will not have any appreciable impact on ground water regime and its quality.

  Permission to withdrawal of groundwater from existing one dugwell @ **95 m^3/day (28500 m^3/year).**

10. BIBLIOGRAPHY

- **Anonymous 2021:** A Comprehensive Hydrogeological Report for Velas Sakhri Sakhri Umbershet Rowale Kavdoli and Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt, Village Umbershet, Post Kelshi, Taluka Dapoli, District Ratnagiri, MH.
- **CGWB, Central Region (2023):** Aquifer Mapping and Management of Ground Water Resources, Ratnagii District, MH.
- **CGWB, Central Region (2014)**: Ground Water Information Ratnagiri District, Maharashtra
- **Survey of India:** Toposheet No. 47G/01.

- **https://indiawris.gov.in/:** CGWB Monitoring well data.
- **https://indiawris.gov.in/:** Evaporation in Ratnagiri District.
- **https://ingres.iith.ac.in** Groundwater Resources 2022-23.
- **CGWB, September-2007**: Manual on Artificial Recharge of Ground Water.
- **Geological Survey of India**: District Resource Map Ratnagiri District.
- **NRSC Data**: Bhuvan Bhujal, LULC.
- **NBC norms 2016:** Calculation for Domestic water demand.
- **Mine Plan-2020:** Approval of review and updation of Rowale Bauxite Mine Plan.
- **https://isis.ramsar.org:** Ramsar Wetlands sites of India.

Annexure-1: Copy of Accreditation certificate

Quality Council of India
National Accreditation Board for Education and Training
ITPI Building, 6th Floor, 4 - A, Ring Road, I P Estate, New Delhi - 110002

CERTIFICATE OF ACCREDITATION

Under the QCI-NABET Scheme
for
Ground Water Consultant Organisation

M/s M K ASSOCIATES

Address: 1413/B-1, GUPTESHWAR ROAD, JABALPUR MADAN MAHAL MADHYA PRADESH JABALPUR-482001

S.No.	SCOPE COVERAGE		
	Industrial Use	Mining Projects	Infrastructure Projects
1	Hydrogeological report: Comprehensive report on groundwater condition/situation		
2	Impact Assessment Reports without modelling studies		

Note: Names of approved Project Coordinators and Technical Area Experts are mentioned in IA AC Minutes datedon QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in NABET's letter of accreditation bearing no. QCI/NABET/GWCO/ACO/22/001 dated Feb 14, 2022. The accreditation needs to be renewed before the expiry date by M/s M K ASSOCIATES following due process of assessment.

Sr. Director, NABET
Issue Date : Feb 14, 2022

Certificate No.
NABET/GWCO/IA/GW023

Valid Upto
Jan 19, 2025

Annexure-2: Copy of Work Order

ASHAPURA
MINECHEM LIMITED

No:
Date: 01-03-2024

To,

M.K.Associates,
CGWA-Accredited Ground Water Professional
1413B-1, Gupteshwar Road,
Madan Mahal, Jabalpur, 482 001.

Sub: Work appointment for Comprehensive Hydrogeological Report.
Ref: Negotiation on telephone

We are pleased to appoint you as Consultant to prepare the Comprehensive Hydrogeological Report for abstraction of groundwater for our industrial Unit M/s Velas Sakhri Sakhri Umbershet Rowale Kavdoli And Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt, located at village Umbershet, Post Kelshi Taluk Dapoli, District Ratnaagiri, Maharshtra 400001 required for submission to Central Ground Water Authority, Government of India for 'No Objection Certificate (NOC)' for abstraction of groundwater.

Signature .....
Seal .....
Name Sangram V Patil
Designation Agent

ASHAPURA MINECHEM LTD. MUMBAI

Regd. Office :

Annexure-3: Copy of NOC

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
केन्द्रीय भूमि जल प्राधिकरण
Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development & Ganga Rejuvenation
Central Ground Water Authority

(भूजल निकासी हेतु अनापत्ति प्रमाण पत्र)

NO OBJECTION CERTIFICATE (NOC) FOR GROUND WATER ABSTRACTION

Project Name:	Velas Sakhri Sakhri Umbershet Rowale Kavdoli And Uttamber Bauxite Mine Dhanwate Jetty Conveyor Belt		
Project Address:	Village Umbershet, Post Kelshi, Taluka Dapoli, District Ratnagiri,		
Village:	Umbarshet	Block:	Dapoli
District:	Ratnagiri	State:	Maharashtra
Pin Code:			
Communication Address:	M/s. Ashapura Minechem Ltd, 278, Jeevan Udyog Building, 3rd Floor D.n.road, Fort,, Mumbai, Mumbai, Mumbai, Maharashtra - 400001		
Address of CGWB Regional Office :	Central Ground Water Board Central Region, N.s. Building, Civil Lines, Nagpur, Maharashtra - 440001		

1.	**NOC No.:**	CGWA/NOC/MIN/REN/2/2022/7161			
2.	Application No.:	21-4/731/MH/MIN/2017	3.	Category: (GWRE 2020)	Safe
4.	Project Status:	Existing Ground Water	5.	NOC Type:	Renewal
6.	**Valid from:**	08/12/2021	7.	**Valid up to:**	07/12/2023

8. Ground Water Abstraction Permitted:

Fresh Water		Saline Water		Dewatering		Total	
m³/day	m³/year	m³/day	m³/year	m³/day	m³/year	m³/day	m³/year
120.00	28800.00						

9. Details of ground water abstraction /Dewatering structures

	Total Existing No.:1						Total Proposed No.:0					
	DW	DCB	BW	TW	MP	MPu	DW	DCB	BW	TW	MP	MPu
Abstraction Structure*	1	0	0	0	0	0	0	0	0	0	0	0

*DW- Dug Well; DCB-Dug-cum-Bore Well; BW-Bore Well; TW-Tube Well; MP-Mine Pit;MPu-Mine Pumps

10.	Ground Water Abstraction/Restoration Charges paid (Rs.):	33300.00

11.	Number of Piezometers(Observation wells) to be constructed/ monitored & Monitoring mechanism.	No. of Piezometers	Monitoring Mechanism		
			Manual	DWLR**	DWLR With Telemetry
	**DWLR - Digital Water Level Recorder	1	0	1	0

(Compliance Conditions given overleaf)

This is an auto generated document & need not to be signed.

CENTRAL GROUND WATER AUTHORITY

18/11, जामनगर हाउस, मानसिंह रोड, नई दिल्ली - 110011 / 18/11, Jamnagar House, Mansingh Road, New Delhi-110011
Phone: (011) 23383561 Fax: 23382051, 23386743
Website: cgwa-noc.gov.in

पानी बचाये – जीवन बचाये
SAVE WATER - SAVE LIFE

Validity of this NOC shall be subject to compliance of the following conditions:

Mandatory conditions:

1) Installation of tamper proof digital water flow meter with telemetry on all the abstraction structure(s) shall be mandatory for all users seeking No Objection Certificate and intimation regarding their installation shall be communicated to the CGWA within 30 days of grant of No Objection Certificate.

2) Proponents shall mandatorily get water flow meter calibrated from an authorized agency once in a year.

3) Construction of purpose-built observation wells (piezometers) for ground water level monitoring shall be mandatory as per Section 14 of Guidelines. Water level data shall be made available to CGWA through web portal. Detailed guidelines for construction of piezometers are given in Annexure-II of the guidelines.

4) Proponents shall monitor quality of ground water from the abstraction structure(s) once in a year. Water samples from bore wells/ tube wells / dug wells shall be collected during April/May every year and analysed in NABL accredited laboratories for basic parameters (cations and anions), heavy metals, pesticides/ organic compounds etc. Water quality data shall be made available to CGWA through the web portal.

5) In case of mining projects, additional key wells shall be established in consultation with the Regional Director, CGWB for ground water level monitoring four (4) times a year (January, May, August and November) in core as well as buffer zones of the mine.

6) In case of mining project the firm shall submit water quality report of mine discharge/ seepage from Govt. approved/ NABL accredited lab.

7) The firm shall report compliance of the NOC conditions online in the website (www.cgwa-noc.gov.in) within one year from the date of issue of this NOC.

8) Industries abstracting ground water in excess of 100 m 3 /d shall undertake annual water audit through certified auditors and submit audit reports within three months of completion of the same to CGWA. All such industries shall be required to reduce their ground water use by at least 20% over the next three years through appropriate means.

9) Application for renewal can be submitted online from 90 days before the expiry of NOC. Ground water withdrawal, if any, after expiry of NOC shall be illegal & liable for legal action as per provisions of Environment (Protection) Act, 1986.

10) This NOC is subject to prevailing Central/State Government rules/laws/norms or Court orders related to construction of tube well/ground water abstraction structure / recharge or conservation structure/discharge of effluents or any such matter as applicable.

General conditions:

11) No additional ground water abstraction and/or de-watering structures shall be constructed for this purpose without prior approval of the Central Ground Water Authority (CGWA).

12) The proponent shall seek prior permission from CGWA for any increase in quantum of groundwater abstraction (more than that permitted in NOC for specific period).

13) Proponents shall install roof top rain water harvesting in the premise as per the existing building bye laws in the premise.

14) The project proponent shall take all necessary measures to prevent contamination of ground water in the premises failing which the firm shall be responsible for any consequences arising thereupon.

15) In case of industries that are likely to contaminate the ground water, no recharge measures shall be taken up by the firm inside the plant premises. The runoff generated from the rooftop shall be stored and put to beneficial use by the firm.

16) Wherever feasible, requirement of water for greenbelt (horticulture) shall be met from recycled / treated waste water.

17) Wherever the NOC is for abstraction of saline water and the existing wells (s) is /are yielding fresh water, the same shall be sealed and new tubewell(s) tapping saline water zone shall be constructed within 3 months of the issuance of NOC. The firm shall also ensure safe disposal of saline residue, if any.

18) Unexpected variations in inflow of ground water into the mine pit, if any, shall be reported to the concerned Regional Director, Central Ground Water Board.

19) In case of violation of any NOC conditions, the applicant shall be liable to pay the penalties as per Section 16 of Guidelines.

20) This NOC does not absolve the proponents of their obligation / requirement to obtain other statutory and administrative clearances from appropriate authorities.

21) The issue of this NOC does not imply that other statutory / administrative clearances shall be granted to the project by the concerned authorities. Such authorities would consider the project on merits and take decisions independently of the NOC.

22) In case of change of ownership, new owner of the industry will have to apply for incorporation of necessary changes in the No Objection Certificate with documentary proof within 60 days of taking over possession of the premises.

23) This NOC is being issued without any prejudice to the directions of the Hon'ble NGT/court orders in cases related to ground water or any other related matters.

24) Proponents, who have installed/constructed artificial recharge structures in compliance of the NOC granted to them previously and have availed rebate of upto 50% (fifty percent) in the ground water abstraction charges/ground water restoration charges, shall continue to regularly maintain artificial recharge structures.

25) Industries which are likely to cause ground water pollution e.g. Tanning, Slaughter Houses, Dye, Chemical/ Petrochemical, Coal washeries, pharmaceutical, other hazardous units etc. (as per CPCB list) need to undertake necessary well head protection measures to ensure prevention of ground water pollution as per Annexure III of the guidelines.

26) In case of new infrastructure projects having ground water abstraction of more than 20 m3/day, the firm/entity shall ensure implementation of dual water supply system in the projects.

27) In case of infrastructure projects, paved/parking area must be covered with interlocking/perforated tiles or other suitable measures to ensure groundwater infiltration/harvesting.

28) In case of coal and other base metal mining projects, the project proponent shall use the advance dewatering technology (by construction of series of dewatering abstraction structures) to avoid contamination of surface water.

29) The NOC issued is conditional subject to the conditions mentioned in the Public notice dated 27.01.2021 failing which penalty/EC/cancellation of NOC shall be imposed as the case may be.
30) This NOC is issued subject to the clearance of Expert Appraisal Committee (EAC) (if applicable).

(Non-compliance of the conditions mentioned above is likely to result in the cancellation of NOC and legal action against the proponent.)

CENTRAL GROUND WATER AUTHORITY

Annexure-4: Groundwater Quality Report

Ground water Quality Report Malvi April -2024

CES ANALYTICAL AND RESEARCH SERVICES (I) PVT. LTD.

Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000548F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/1

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/01 (Dugwell) Malvi Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.08
2	Turbidity	NTU	2130 B	1	5	0.70
3	Conductivity	µmhos/cm	2510 B	-	-	222.40
4	Total Alkalinity	mg/lit	2320 B	200	600	58.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	70.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	52.00
7	Calcium as Ca	mg/lit	3500 B	75	200	8.81
8	Magnesium as Mg	mg/lit	3500 B	30	100	7.29
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	21.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	3.21
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	0.05
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.05
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.32
14	Sodium as Na	mg/lit	3500- Na B	-	-	14.20
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory SANTOSH KHANTAL QUALITY MANAGER

The Results relate only to the sample tested/Sampled
Note:-The report will not valid for legal case, if Prior permission not taken from CES.
----------*End of Report*---------

42, 48, Doorsanchar Nagar, Near Savoy Complex, E-8 Extension, Gulmohar, Bhopal-462 039 (M.P.)
Telephone : 0755-4299319, Fax : 0755-4243510, Mobile : 9425009319
Email: cesanalytical@gmail.com, creativelab.bpl@gmail.com, Websearch : www.creativeenviroservices.com

Note:
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CES ANALYTICAL AND RESEARCH SERVICES (I) PVT. LTD.

Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000307F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/1

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/01 (Dugwell) Malvi Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

The Results relate only to the sample tested/Sampled
Note:-The report will not valid for legal case, if Prior permission not taken from CES.

----------*End of Report*---------

DR. SURENDRA SARSAIYA
TECHNICAL MANAGER
(BIOLOGICAL)

42, 48, Doorsanchar Nagar, Near Savoy Complex, E-8 Extension, Gulmohar, Bhopal-462 039 (M.P.)
Telephone : 0755-4299319, Fax : 0755-4243510, Mobile : 9425009319
Email: cesanalytical@gmail.com, creativelab.bpl@gmail.com, Websearch : www.creativeenviroservices.com

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Ground water Quality Report Borthal April -2024

CES ANALYTICAL AND RESEARCH SERVICES (I) PVT. LTD.

Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000549F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/2

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/02 (Dugwell) Borthal, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.77
2	Turbidity	NTU	2130 B	1	5	<0.10
3	Conductivity	µmhos/cm	2510 B	-	-	324.00
4	Total Alkalinity	mg/lit	2320 B	200	600	144.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	201.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	114.00
7	Calcium as Ca	mg/lit	3500 B	75	200	40.08
8	Magnesium as Mg	mg/lit	3500 B	30	100	3.40
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	18.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	6.23
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	0.12
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.05
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.11
14	Sodium as Na	mg/lit	3500- Na B	-	-	12.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:

NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory

SANTOSH KHANTAL
QUALITY MANAGER

The Results relate only to the sample tested/Sampled
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----------*End of Report*---------

42, 48, Doorsanchar Nagar, Near Savoy Complex, E-8 Extension, Gulmohar, Bhopal-462 039 (M.P.)
Telephone : 0755-4299319, Fax : 0755-4243510, Mobile : 9425009319
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CES ANALYTICAL AND RESEARCH SERVICES (I) PVT. LTD.

Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000308F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing	**Sample tested as received**	: Ok
Sub Group: Ground Water		
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/2

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/02 (Dugwell) Borthal, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

DR. SURENDRA SARSAIYA TECHNICAL MANAGER (BIOLOGICAL)

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----------*End of Report*---------

42, 48, Doorsanchar Nagar, Near Savoy Complex, E-8 Extension, Gulmohar, Bhopal-462 039 (M.P.)
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Ground water Quality Report Panchpandri April -2024

CES ANALYTICAL AND RESEARCH SERVICES (I) PVT. LTD.

Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000550F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 09.04.2024
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Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/3

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/03 (Dugwell) Panchpandri, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.44
2	Turbidity	NTU	2130 B	1	5	6.30
3	Conductivity	µmhos/cm	2510 B	-	-	860.00
4	Total Alkalinity	mg/lit	2320 B	200	600	92.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	516.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	228.00
7	Calcium as Ca	mg/lit	3500 B	75	200	54.50
8	Magnesium as Mg	mg/lit	3500 B	30	100	22.35
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	180.94
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	43.93
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	16.39
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.06
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.22
14	Sodium as Na	mg/lit	3500- Na B	-	-	15.60
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

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Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

SANTOSH KHANTAL QUALITY MANAGER

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC6872247000000309F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/3

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/03 (Dugwell) Panchpandri, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

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DR. SURENDRA SARSAIYA TECHNICAL MANAGER (BIOLOGICAL)

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TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000551F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/4

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/04 (Dugwell) Anjarle, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	7.07
2	Turbidity	NTU	2130 B	1	5	0.20
3	Conductivity	µmhos/cm	2510 B	-	-	515.00
4	Total Alkalinity	mg/lit	2320 B	200	600	202.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	272.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	234.00
7	Calcium as Ca	mg/lit	3500 B	75	200	30.46
8	Magnesium as Mg	mg/lit	3500 B	30	100	38.39
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	32.98
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	37.68
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	2.87
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.06
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.30
14	Sodium as Na	mg/lit	3500- Na B	-	-	18.70
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:- NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory SANTOSH KHANTAL QUALITY MANAGER

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TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000310F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/4

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/04 (Dugwell) Anjarle, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

DR. SURENDRA SARSAIYA TECHNICAL MANAGER (BIOLOGICAL)

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TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000552F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/5

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/05 (Borewell) Ambavoli, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.15
2	Turbidity	NTU	2130 B	1	5	1.30
3	Conductivity	µmhos/cm	2510 B	-	-	111.00
4	Total Alkalinity	mg/lit	2320 B	200	600	40.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	47.90
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	32.00
7	Calcium as Ca	mg/lit	3500 B	75	200	5.61
8	Magnesium as Mg	mg/lit	3500 B	30	100	4.37
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	17.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	5.99
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	0.87
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.13
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.28
14	Sodium as Na	mg/lit	3500- Na B	-	-	21.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:

NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory

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QUALITY MANAGER

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TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000311F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/5

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/05 (Borewell) Ambavoli, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

DR. SURENDRA SARSAIYA TECHNICAL MANAGER (BIOLOGICAL)

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TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000554F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/7

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/07 (Dugwell) Shipole, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.64
2	Turbidity	NTU	2130 B	1	5	0.20
3	Conductivity	µmhos/cm	2510 B	-	-	227.30
4	Total Alkalinity	mg/lit	2320 B	200	600	76.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	134.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	78.00
7	Calcium as Ca	mg/lit	3500 B	75	200	18.43
8	Magnesium as Mg	mg/lit	3500 B	30	100	7.77
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	18.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	8.00
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	12.27
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.05
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.52
14	Sodium as Na	mg/lit	3500- Na B	-	-	14.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:
NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory

SANTOSH KHANTAL
QUALITY MANAGER

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TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000313F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/7

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/07 (Dugwell) Shipole, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

DR. SURENDRA SARSAIYA TECHNICAL MANAGER (BIOLOGICAL)

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TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000555F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/8

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/08 (Dugwell) Nayane, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.59
2	Turbidity	NTU	2130 B	1	5	0.30
3	Conductivity	µmhos/cm	2510 B	-	-	54.17
4	Total Alkalinity	mg/lit	2320 B	200	600	26.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	19.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	22.00
7	Calcium as Ca	mg/lit	3500 B	75	200	4.00
8	Magnesium as Mg	mg/lit	3500 B	30	100	2.91
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	12.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	5.81
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	0.30
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.06
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.45
14	Sodium as Na	mg/lit	3500- Na B	-	-	11.80
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:
NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory
SANTOSH KHANTAL
QUALITY MANAGER

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000314F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/8

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/08 (Dugwell) Nayane, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

The Results relate only to the sample tested/Sampled
Note:-The report will not valid for legal case, if Prior permission not taken from CES.

----------*End of Report*---------

DR. SURENDRA SARSAIYA TECHNICAL MANAGER (BIOLOGICAL)

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Ground water Quality Report Devhare April -2024

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Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer To, **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC6872240000000556F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/9

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/09 (Dugwell) Devhare, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.41
2	Turbidity	NTU	2130 B	1	5	0.10
3	Conductivity	µmhos/cm	2510 B	-	-	135.00
4	Total Alkalinity	mg/lit	2320 B	200	600	32.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	61.30
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	32.00
7	Calcium as Ca	mg/lit	3500 B	75	200	11.22
8	Magnesium as Mg	mg/lit	3500 B	30	100	0.97
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	40.00
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	7.02
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	7.98
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.05
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.22
14	Sodium as Na	mg/lit	3500- Na B	-	-	15.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:

NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory

SANTOSH KHANTAL
QUALITY MANAGER

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----------*End of Report*----------

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Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000315F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/9

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/09 (Dugwell) Devhare, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

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----------*End of Report*---------

DR. SURENDRA SARSAIYA
TECHNICAL MANAGER
(BIOLOGICAL)

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Ground water Quality Report Umbershet Mine April -2024

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Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000557F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/10

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/10 (Mine Water) Umbershet Mine Pit, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.84
2	Turbidity	NTU	2130 B	1	5	0.40
3	Conductivity	µmhos/cm	2510 B	-	-	110.50
4	Total Alkalinity	mg/lit	2320 B	200	600	16.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	24.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	10.00
7	Calcium as Ca	mg/lit	3500 B	75	200	3.20
8	Magnesium as Mg	mg/lit	3500 B	30	100	0.48
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	16.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	5.68
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	2.73
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.0c
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.48
14	Sodium as Na	mg/lit	3500- Na B	-	-	16.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:
NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory
SANTOSH KHANTAL
QUALITY MANAGER

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC6872247000000316F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/10

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/10 (Mine Water) Umbershet Mine Pit, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	17.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

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DR. SURENDRA SARSAIYA TECHNICAL MANAGER (BIOLOGICAL)

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Ground water Quality Report Dauli April -2024

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Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000558F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/11

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/11 (Borewell) Dauli, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.31
2	Turbidity	NTU	2130 B	1	5	0.70
3	Conductivity	µmhos/cm	2510 B	-	-	74.17
4	Total Alkalinity	mg/lit	2320 B	200	600	32.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	38.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	24.00
7	Calcium as Ca	mg/lit	3500 B	75	200	7.21
8	Magnesium as Mg	mg/lit	3500 B	30	100	1.45
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	15.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	4.60
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	1.36
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.06
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.28
14	Sodium as Na	mg/lit	3500- Na B	-	-	18.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:
NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory
SANTOSH KHANTAL
QUALITY MANAGER

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Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000317F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/11

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/11 (Borewell) Dauli, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

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----------*End of Report*---------

DR. SURENDRA SARSAIYA
TECHNICAL MANAGER
(BIOLOGICAL)

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Ground water Quality Report Varsai April -2024

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Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000559F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/12

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/12 (Dugwell) Virsai, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.37
2	Turbidity	NTU	2130 B	1	5	0.8
3	Conductivity	µmhos/cm	2510 B	-	-	48.67
4	Total Alkalinity	mg/lit	2320 B	200	600	26.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	25.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	16.00
7	Calcium as Ca	mg/lit	3500 B	75	200	4.80
8	Magnesium as Mg	mg/lit	3500 B	30	100	0.97
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	13.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	1.77
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	0.38
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	<0.05
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	<0.10
14	Sodium as Na	mg/lit	3500- Na B	-	-	17.50
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:

NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory

SANTOSH KHANTAL
QUALITY MANAGER

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----------*End of Report*---------

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Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-687

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000318F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/12

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/12 (Dugwell) Virsai, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

The Results relate only to the sample tested/Sampled

Note:-The report will not valid for legal case, if Prior permission not taken from CES.

---------*End of Report*---------

DR. SURENDRA SARSAIYA TECHNICAL MANAGER (BIOLOGICAL)

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC68722400000000560F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/13

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/13 (Dugwell) Gauliwadi, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.33
2	Turbidity	NTU	2130 B	1	5	1.40
3	Conductivity	µmhos/cm	2510 B	-	-	83.00
4	Total Alkalinity	mg/lit	2320 B	200	600	38.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	42.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	36.00
7	Calcium as Ca	mg/lit	3500 B	75	200	8.01
8	Magnesium as Mg	mg/lit	3500 B	30	100	3.88
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	15.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	3.36
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	0.53
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.08
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.66
14	Sodium as Na	mg/lit	3500- Na B	-	-	14.90
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:

NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory

SANTOSH KHANTAL
QUALITY MANAGER

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Accreditated Organisation by National Accreditation Board for Testing and Calibration Laboratories (NABL) CIN : U74999MP2020PTC052747

TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC6872247000000319F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/13

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/13 (Dugwell) Gauliwadi, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

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DR. SURENDRA SARSAIYA
TECHNICAL MANAGER
(BIOLOGICAL)

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Ground water Quality Report Rovale April -2024

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224000000561F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/14

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/14 (Borewell) Rovale, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	6.75
2	Turbidity	NTU	2130 B	1	5	3.50
3	Conductivity	µmhos/cm	2510 B	-	-	101.30
4	Total Alkalinity	mg/lit	2320 B	200	600	50.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	52.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	40.00
7	Calcium as Ca	mg/lit	3500 B	75	200	12.02
8	Magnesium as Mg	mg/lit	3500 B	30	100	2.43
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	14.99
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	4.05
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	0.61
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.11
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.45
14	Sodium as Na	mg/lit	3500- Na B	-	-	12.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:

NEELAM UPADHYAY
TECHNICAL MANAGER

Authorized Signatory

SANTOSH KHANTAL
QUALITY MANAGER

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000320F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 11.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Ground Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/14

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/14 (Borewell) Rovale, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	<2.00

For CES Analytical and Research Services (I) Pvt. Ltd

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Annexure-5: Surface water Quality Report

Surface water Quality Report Bharja River April -2024

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC68722400000000563F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Surface Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/16

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/16 (Dhandhi Nadi) Bharja River, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	7.38
2	Turbidity	NTU	2130 B	1	5	0.60
3	Conductivity	µmhos/cm	2510 B	-	-	3103.00
4	Total Alkalinity	mg/lit	2320 B	200	600	50.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	1346.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	304.00
7	Calcium as Ca	mg/lit	3500 B	75	200	31.26
8	Magnesium as Mg	mg/lit	3500 B	30	100	54.91
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	714.00
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	50.52
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	0.99
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.07
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.56
14	Sodium as Na	mg/lit	3500- Na B	-	-	26.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt Ltd

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TECHNICAL MANAGER

Authorized Signatory

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000322F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 10.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Surface Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/16

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/16 (Dhandhi Nadi) Bharja River, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	33.00

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Authorized Signatory

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Quality Report Sea Water April -2024

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd.,** **Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC68722400000000562F** **Test Report No:- CES/LAB/Water/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 2 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: packed	**Method of sampling**	: As Per Client
Sample Discipline: Chemical Testing **Sub Group:** Surface Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. Of Sample**	: 270/15

S. No.	Test Parameters	Unit	Test method	Requirement as per IS-10500-2012		Result Obtained MKA/24-25/15 (Sea Water) Sea Water, Block-Dapoli, District-Ratnagiri, Maharashtra
				Desirable Limit	Permissible limit	
1	pH	-	4500 H+B	6.5 -8.5	No relaxation	7.54
2	Turbidity	NTU	2130 B	1	5	1.80
3	Conductivity	µmhos/cm	2510 B	-	-	77360.00
4	Total Alkalinity	mg/lit	2320 B	200	600	120.00
5	Total Dissolved solid	mg/lit	2540 B	500	2000	39340.00
6	Total Hardness as $CaCO_3$	mg/lit	2340 C	200	600	6900.00
7	Calcium as Ca	mg/lit	3500 B	75	200	480.96
8	Magnesium as Mg	mg/lit	3500 B	30	100	1385.10
9	Chlorides as Cl	mg/lit	4500-Cl B	250	1000	21243.38
10	Sulphates as SO_4	mg/lit	4500-SO_4 E	200	400	81.51
11	Nitrate as NO_3	mg/lit	4500-NO_3 B	45	No relaxation	1.85
12	Iron as Fe	mg/lit	3500-Fe B	0.3	No relaxation	0.07
13	Fluoride as F	mg/lit	4500- F D	1.0	1.5	0.91
14	Sodium as Na	mg/lit	3500- Na B	-	-	36.00
15	Aluminium as Al	mg/lit	IS:3025 P-65 ICP-MS	0.03	0.20	<0.003

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By:

NEELAM UPADHYAY
TECHNICAL MANAGER

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TC-6872

TEST REPORT

Name & Address of the Customer **To,** **M/s Ashapura Minechem Ltd., Umbershet Bauxite Mine, Rowale Bauxite Mine, Taluka Dapoli, District Ratnagiri, Maharashtra.**	**ULR No: TC687224700000321F** **Test Report No:- CES/LAB/Micro/24/270** Dispatch No: 449 Issue Date: 22.04.2024 Client Ref: Nil Date : Nil	
Qty : 1 No. x 1 litre	**Date of Collection**	: 09.04.2024
Method of test : Given Below	**Date of Receipt**	: 15.04.2024
Packing :- Plastic bottle	**Period of testing**	: 15.04.2024 to 22.04.2024
Sample Condition at receipt: Packed	**Method of sampling**	: As Per Client
Sample Discipline: Biological Testing **Sub Group:** Surface Water	**Sample tested as received**	: Ok
Sample collected by: M.K. Associates	**Page no.**	: 1 of 1
No. of Sample - 16	**Serial No. of Sample**	: 270/15

S. No.	Test Parameters	Unit	Method No.	Result Obtained MKA/24-25/15 (Sea Water) Sea Water, Block-Dapoli, District-Ratnagiri, Maharashtra
1	E. Coli	MPN/100ml	IS:1622:1981	70.00

For CES Analytical and Research Services (I) Pvt. Ltd

Checked By: NEELAM UPADHYAY TECHNICAL MANAGER

Authorized Signatory

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National Accreditation Board for Testing and Calibration Laboratories

NABL

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CES ANALYTICAL AND RESEARCH SERVICES INDIA PRIVATE LIMITED

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

42, 48, DOORSANCHAR NAGAR, E8 EXTENSION, ARERA COLONY, BHOPAL, MADHYA PRADESH, INDIA

in the field of

TESTING

Certificate Number:	**TC-6872**		
Issue Date:	**04/02/2023**	**Valid Until:**	**03/02/2025**

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : CES ANALYTICAL AND RESEARCH SERVICES INDIA PRIVATE LIMITED

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

Groundwater quality report Opencast mine pit March -2023

Gaheli Environmental Laboratory
(A unit of Gaheli Center of Research and Development Pvt. Ltd.)
(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company & NABL Accredited Laboratory)
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Tel.: 0286-2253630, Mobile: +91-9990416608, GSTIN : 24AHCPA6690B1ZV

TEST REPORT

Report Code: GEL/GW/2023/03/21-001
Issued To: Rowale Bauxite Mine
Village – Rowale, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : 21.03.2023
Date of Sampling : 02.03.2023
Sample Received On : 06.03.2023
Analysis Duration : 06.03.2023 to 08.03.2023

Sample Description: Ground Water

RESULTS
(Ground Water Quality Analysis)

S. No.	Parameters	Units	Limits (as per IS:10500-2012)		Rowale Open Well	Kavdoli Open Well	Test Method
			Desirable Limit	Results	Results	Results	
1	Colour*	Hazen	5	15	<5	<5	IS : 3025 (Pt-4) 1983, RA 2017
2	Odour*	-	Agreeable	Agreeable	Agreeable	Agreeable	IS : 3025 (Pt-5) 1983, RA 2017
3	Taste*	-	Agreeable	Agreeable	--	--	IS : 3025 (Pt-8)-1984, RA 2017
4	Turbidity	NTU	1	5	<1	<1	IS: 3025 (Pt-10)-1984,RA 2017
5	pH Value	-	6.5-8.5	No Relaxation	7.36	7.22	IS : 3025 (Pt-11)1983, RA 2017
6	Total Hardness (as $CaCO_3$)	mg/l	200	600	253	239	IS : 3025 (Pt-21)1983, RA 2014
7	Iron (as Fe)	mg/l	0.3	No Relaxation	<0.1	<0.1	3111B (AAS), APHA 23nd Ed. 2017
8	Chlorides (as Cl)	mg/l	250	1000	59	70	IS : 3025 (Pt-32)1988, RA 2014
9	Fluoride (as F)	mg/l	1	1.5	<0.1	<0.1	4500F(D), APHA 23nd Ed. 2017
10	Total Dissolved Solids (TDS)	mg/l	500	2000	532	635	IS: 3025(Pt-16)1984, RA 2017
11	Calcium (as Ca^{2+})	mg/l	75	200	72	80	IS : 3025 (Pt-40)1991, RA 2014

GAHELI ENVIRONMENTAL LABORATORY * PORBANDAR *

Authorized Signatory
Kumar Ashish
(Proprietor)

Serial No.: 1372

ISO 9001:2015 QUALITY | ISO 14001:2015 ENVIRONMENT | OHSAS 18001:2007 Safety and health at work

Dispatch Date: 21.03.2023
Dispatch No.: 1372

Gaheli Environmental Laboratory
(A unit of Gaheli Center of Research and Development Pvt. Ltd.)
(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company & NABL Accredited Laboratory)
Circuit House Road, Near Parwani Orthopadic Hospital, New Paradise Fountain Circle,
Porbandar - 360575, Gujarat, E-mail - contact@gerdindia.com, website - www.gerdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, GSTIN : 24AHCPA6690B1ZV

TEST REPORT

12	Magnesium (as Mg^{2+})	mg/l	30	100	14.3	10.7	By Calculation
13	Copper (as Cu)	mg/l	0.05	1.5	<0.05	<0.05	3111B (AAS), APHA 23nd Ed. 2017
14	Manganese(as Mn)	mg/l	0.1	0.3	<0.1	<0.1	3111B (AAS), APHA 23nd Ed. 2017
15	Sulphate (as SO_4)	mg/l	200	400	10	12	IS : 3025(Pt-24)1986, RA 2014
16	Nitrate(as NO_3)	mg/l	45	No Relaxation	1.2	1.1	IS : 3025(Pt-34)1988, RA 2014
17	Phenolic Compounds*	mg/l	0.001	0.002	<0.001	<0.001	IS : 3025(Pt-43)1992, RA 2014
18	Mercury*	mg/l	0.001	No Relaxation	<0.001	<0.001	3114 (AAS), APHA 23nd Ed. 2017
19	Cadmium (as Cd)	mg/l	0.003	No Relaxation	<0.01	<0.01	3111B (AAS), APHA 23nd Ed. 2017
20	Selenium (as Se)*	mg/l	0.01	No Relaxation	<0.01	<0.01	3114 (AAS), APHA 23nd Ed. 2017
21	Arsenic (as As)*	mg/l	0.01	0.05	<0.01	<0.01	3114 (AAS), APHA 23nd Ed. 2017
22	Cyanide*	mg/l	0.05	No Relaxation	<0.01	<0.01	IS : 3025(Pt-27)1986, RA 2014
23	Lead (as Pb)	mg/l	0.01	No Relaxation	<0.01	<0.01	3111B (AAS), APHA 23nd Ed. 2017
24	Zinc (as Zn)	mg/l	5	15	<0.5	<0.5	3111B (AAS), APHA 23nd Ed. 2017
25	Chromium (as Cr^{6+})	mg/l	0.05	No Relaxation	<0.05	<0.05	IS : 3025(Pt-52)-2003 RA 2014
26	Alkalinity (as $CaCO_3$)	mg/l	200	600	78	89	IS: 3025(Pt-23)1986, RA 2014
27	Boron (as B)	mg/l	0.5	1	<0.1	<0.1	3111B (AAS), APHA 23nd Ed. 2017
28	Phosphorous (as P)	mg/l	-	-	<0.1	<0.1	APHA 23rd Edition 2017-4500 P,D
29	Sodium (as Na)	mg/l	-	-	<5.0	<5.0	IS : 3025(Pt-45) 1993, RA 2019

'' This parameters is not under NABL Scope.*

End of Report

Authorized Signatory
Kumar Ashish
(Proprietor)

Serial No.: 1373

ISO 9001:2015 QUALITY | ISO 14001:2015 ENVIRONMENT | OHSAS 18001:2007 Safety and health at work

Dispatch Date: 21.03.2023

Dispatch No.: 1373

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Circuit House Road, Near Parwani Orthopadic Hospital, New Paradise Fountain Circle,
Porbandar - 360575, Gujarat, E-mail - contact@gerdindia.com, website - www.gerdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, GSTIN : 24AHCPA6690B1ZV

TEST REPORT

Report Code: GEL/GW/2023/03/21-001
Issued To: Umbershet Bauxite Mine
Village – Umbershet, Taluka – Dapoli,
District – Ratnagiri (Maharastra)

Issue Date : 21.03.2023
Date of Sampling : 06.03.2023
Sample Received On: 11.03.2023
Analysis Duration : 11.03.2023 to 15.03.2023

Sample Description: Ground Water

RESULTS
(Ground Water Quality Analysis)

S. No.	Parameters	Units	Limits (as per IS:10500-2012)		Rowale Open Well	Kavdoli Open Well	Test Method
			Desirable Limit	Results	Results	Results	
1	Color*	Hazen	5	15	<5	<5	IS : 3025 (Pt-4) 1983, RA 2017
2	Odour*	-	Agreeable	Agreeable	Agreeable	Agreeable	IS : 3025 (Pt-5) 1983, RA 2017
3	Taste*	-	Agreeable	Agreeable	--	--	IS : 3025 (Pt-8)-1984, RA 2017
4	Turbidity	NTU	1	5	<1	<1	IS: 3025 (Pt-10)-1984,RA 2017
5	pH Value	-	6.5-8.5	No Relaxation	7.35	7.21	IS : 3025 (Pt-11)1983, RA 2017
6	Total Hardness (as $CaCO_3$)	mg/l	200	600	256	239	IS : 3025 (Pt-21)1983, RA 2014
7	Iron (as Fe)	mg/l	0.3	No Relaxation	<0.1	<0.1	3111B (AAS), APHA 23nd Ed. 2017
8	Chlorides (as Cl)	mg/l	250	1000	59	70	IS : 3025 (Pt-32)1988, RA 2014
9	Fluoride (as F)	mg/l	1	1.5	<0.1	<0.1	4500F(D), APHA 23nd Ed. 2017
10	Total Dissolved Solids (TDS)	mg/l	500	2000	561	632	IS: 3025(Pt-16)1984, RA 2017
11	Calcium (as Ca^{2+})	mg/l	75	200	75	82	IS : 3025 (Pt-40)1991, RA 2014

GAHELI ENVIRONMENTAL LABORATORY PORBANDAR

Authorized Signatory
Kumar Ashish
(Proprietor)

Serial No.: 1386

ISO 9001:2015 QUALITY ISO 14001:2015 ENVIRONMENT OHSAS 18001:2007 Safety and health at work

Dispatch Date: 21.03.2023
Dispatch No.: 1386

Gaheli Environmental Laboratory
(A unit of Gaheli Center of Research and Development Pvt. Ltd.)
(ISO 9001:2015, 14001:2015, OHSAS 18001:2007 Certified Company & NABL Accredited Laboratory)
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Porbandar - 360575, Gujarat, E-mail - contact@gerdindia.com, website - www.gerdindia.com
Tel.: 0286-2253630, Mobile: +91-9990416608, GSTIN : 24AHCPA6690B1ZV

TEST REPORT

12	Magnesium (as Mg^{2+})	mg/l	30	100	12.3	8.7	By Calculation
13	Copper (as Cu)	mg/l	0.05	1.5	<0.05	<0.05	3111B (AAS), APHA 23nd Ed. 2017
14	Manganese(as Mn)	mg/l	0.1	0.3	<0.1	<0.1	3111B (AAS), APHA 23nd Ed. 2017
15	Sulphate (as SO_4)	mg/l	200	400	10	12	IS : 3025(Pt-24)1986, RA 2014
16	Nitrate(as NO_3)	mg/l	45	No Relaxation	1.2	1.1	IS : 3025(Pt-34)1988, RA 2014
17	Phenolic Compounds*	mg/l	0.001	0.002	<0.001	<0.001	IS : 3025(Pt-43)1992, RA 2014
18	Mercury*	mg/l	0.001	No Relaxation	<0.001	<0.001	3114 (AAS), APHA 23nd Ed. 2017
19	Cadmium (as Cd)	mg/l	0.003	No Relaxation	<0.01	<0.01	3111B (AAS), APHA 23nd Ed. 2017
20	Selenium (as Se)*	mg/l	0.01	No Relaxation	<0.01	<0.01	3114 (AAS), APHA 23nd Ed. 2017
21	Arsenic (as As)*	mg/l	0.01	0.05	<0.01	<0.01	3114 (AAS), APHA 23nd Ed. 2017
22	Cyanide*	mg/l	0.05	No Relaxation	<0.01	<0.01	IS : 3025(Pt-27)1986, RA 2014
23	Lead (as Pb)	mg/l	0.01	No Relaxation	<0.01	<0.01	3111B (AAS), APHA 23nd Ed. 2017
24	Zinc (as Zn)	mg/l	5	15	<0.5	<0.5	3111B (AAS), APHA 23nd Ed. 2017
25	Chromium (as Cr^{6+})	mg/l	0.05	No Relaxation	<0.05	<0.05	IS : 3025(Pt-52)-2003 RA 2014
26	Alkalinity (as $CaCO_3$)	mg/l	200	600	79	85	IS: 3025(Pt-23)1986, RA 2014
27	Boron (as B)	mg/l	0.5	1	<0.1	<0.1	3111B (AAS), APHA 23nd Ed. 2017
28	Phosphorous (as P)	mg/l	-	-	<0.1	<0.1	APHA 23rd Edition 2017-4500 P,D
29	Sodium (as Na)	mg/l	-	-	<5.0	<5.0	IS : 3025(Pt-45) 1993, RA 2019

'' This parameters is not under NABL Scope.*

End of Report

Authorized Signatory
Kumar Ashish
(Proprietor)

Serial No.: 1387

ISO 9001:2015 QUALITY ISO 14001:2015 ENVIRONMENT OHSAS 18001:2007 Safety and health at work

Dispatch Date: 21.03.2023

Dispatch No.: 1387

Annexure-6: Mining Plan

BY REGISTERED PARCEL

भारत सरकार/Government of India
खान मंत्रालय/Ministry of Mines
भारतीय खान ब्यूरो/Indian Bureau of Mines
क्षेत्रीय खान नियंत्रक, गोवा का कार्यालय/Office of the RCOM, Goa

Phone No.: (0832)-2741757
Fax No. : (0832)-2741758
E-mail : ro.goa@ibm.gov.in

Opp. R.T.O. Office,
P.O. FATORDA - 403 602,
MARGAO - GOA.

No. RMP/MECH-08(MAH)/GOA/2019-20

Date: 30.07.2020

M/s. Ashapura Minechem Ltd.,
Jeevan Udyog Building,
3rd floor, 278,
D.N.Road, Fort,
Mumbai – 400 001,
Maharashtra.

Sub: Approval of Review and Updation of Mining Plan with Progressive Mine Closure Plan in respect of your Rovale Bauxite Ore Mine over an area of 218.285 Ha. situated in Rovale Village, Dapoli Taluka, Ratnagiri District of Maharashtra State submitted under Rule 17(2) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules, 2016.

Ref : (i) Your Letter No. Nil dated 13.03.2020 submitting a draft copy of Review and Updation of Mining Plan in respect of aforesaid mine.
(ii) This office letter of even no. dated 31.03.2020 conveying **provisional approval** of the document in the light of Nationwide Lockdown due to COVID-19 outbreak.
(iii) This office letter of even no. dated 10.07.2020
(iv) Your Letter No. AML/REPLY-Sub-RMP-Rowale/IBM/GOA/004 dated Nil received on 16.07.2020 submitting three bound copies of modified document i.r.o. aforesaid mine.
(v) Your Letter No. AML/DPL/LIA-74 dated 05.02.2020 submitting letter of extension of validity of Bank Guarantees for an amount of Rs. 26,00,000/- and Rs. 1,40,84,500/- upto 31.03.2025 and additional Bank Guarantee for an amount of Rs. 23,91,000/- bearing Guarantee No. 0381IGFIN000720 dated 31.01.2020 valid upto 31.03.2025 from Bank of Baroda, Mumbai Main Office Branch, Fort, Mumbai, Maharashtra.

Sirs,

In exercise of the powers conferred by clause (b) of sub-section (2) of section 5 of the Mines & Minerals (Development & Regulation) Act, 1957 read with Government of India Order No.S.O.445(E) dated 28.04.1987 and S.O.1857(E) dated 18.05.2016; I hereby approve the Review & Updation of Mining Plan including Progressive Mine Closure Plan in respect

2/-

Annexure-7

Letter from Project proponent regarding no dewatering is being done in the project lease area

ASHAPURA
MINECHEM LIMITED

Date: 14/05/2024

This is to certify that no dewatering is being done in our mine. All the rain water and mine seepage are accumulated in mine pit. Due to steeply sloping terrain rain water is not collected in Rowale Mine.

For dust suppression and green belt development groundwater utilised from existing one Dugwell.

Authorised Signatory
For Ashapura Minechem Limited

ASHAPURA MINECHEM LTD. DAPOLI

Regd. Office :
Jeevan Udyog Building, 3rd Floor, 278, D. N. Road, Fort, Mumbai - 400 001. (India)
Tel.: +91-22 6665 1700 • Email: info@ashapura.com • www.ashapura.com
CIN No. : L14108MH1982PLC026396

Annexure-8

This is to certify that report entitled **"Comprehensive Hydrogeology Report for M/s Ashapura Minechem Limited, Bauxite Mine (318.146 Ha.), Village- Umbershet, Post-Kelshi, Taluka- Dapoli, District: Ratnagiri, Maharashtra"** is prepared by following Team Members of M.K. Associates.

Sr. No.	Name	Designation	In House/Empanelled
1	Mr. Manish Khatri	Hydrogeologist	In House
2	Mr. Neelkanth Dixit	Water Quality Expert	In House
3	Mr. Ram Milan Verma	Hydrogeologist	In House
4	Mr. Hari Shankar Namdeo	Geophysicist	Empanelled

NOCAP
https://cgwa-noc.gov.in/ExternalUser/Revival/Revivalrequest.aspx
Gmail YouTube Maps Favourites Windy: Wind map... CoWIN Home | Income Tax... Home - Unique Ide... Home | Parivahan S... Jockey India Mineral Block Auction Home - Voter Portal...

Government of India
Ministry of Jal Shakti
Department of Water Resources, River Development and Ganga Rejuvenation
Central Ground Water Authority (CGWA)

Application for Issue of NOC to Abstract Ground Water (NOCAP)

ANNEXURE-R-15

Welcome : marutibauskar
Previous Login Date Time: 13/08/2024 12:06:16 PM , **IP Address:** 152.57.198.84
Logout

Applicant Home | Apply | Feedback | Change Password | Update PAN | Profile | Grievance | Submitted Application Payment | User Request
Application Pass Book | Upload IAR | Upload Attachment | Payment for Associate

Revival Request

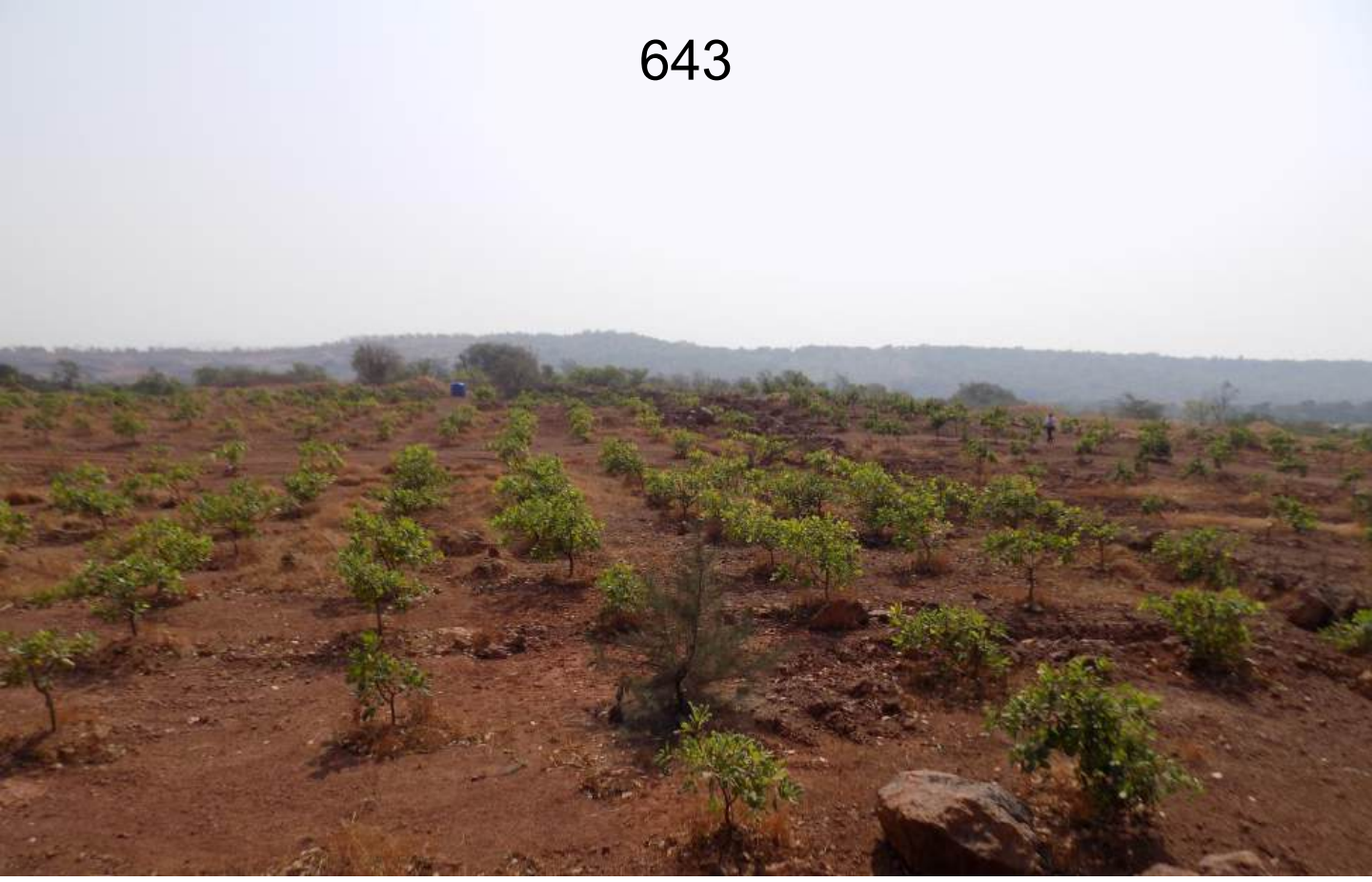
Application Name: VELAS SAKHRI SAKHRI UMI

History

S.No.	Application Name	Application Number	Application Type	Reason To Revive	Request On	Documents		Status
1	VELAS SAKHRI SAKHRI UMBERSHET ROWALE KAVDOLI AND UTTAMBER BAUXITE MINE DHANWATE JETTY CONVEYOR BELT	21-4/731/MH/MIN/2017	Mining	Respected Sir, Please find the attachment of CHR report along with payment screenshot of NOCAP.	18/05/2024	1 Comprehensive Hydrogeological Report For Ashapura	Download/View	Open
						2 Print snip.pdf	Download/View	

TRUE COPY ADVOCATE

ENG IN 09:50:00 17-08-2024



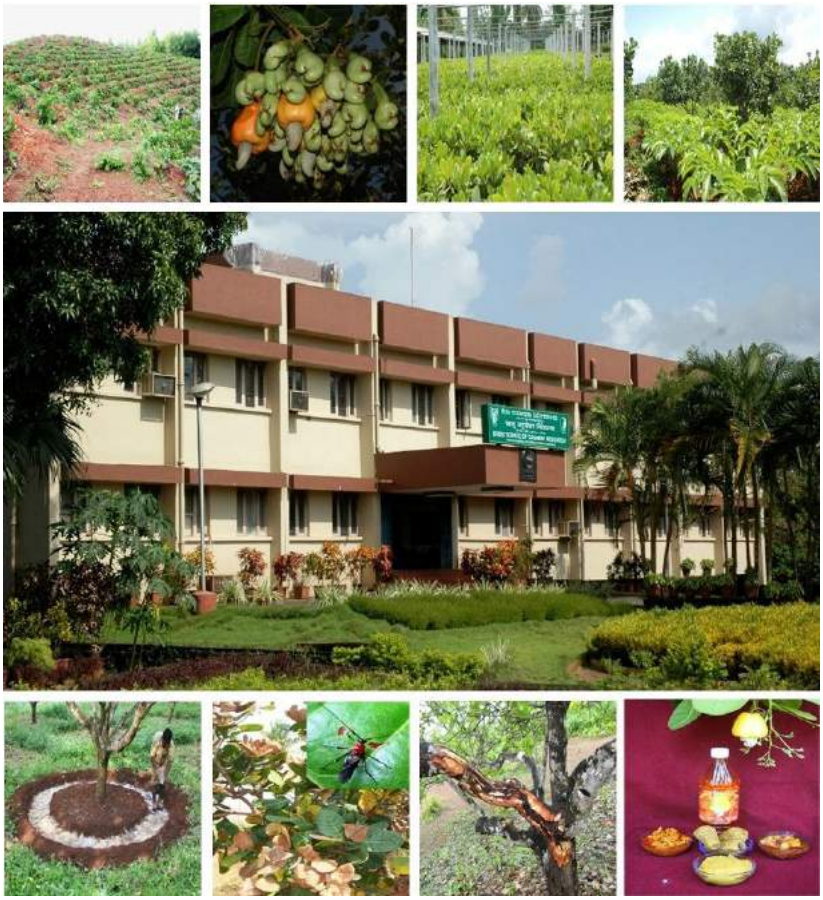
TRUE COPY
ADVOCATE

ANNEXURE-R-17

Lecture Notes Series 24

E-Manual on

Advances in Cashew Production Technology



ಐ.ಸಿ.ಎ.ಆರ್. – ಗೇರು ಸಂಶೋಧನಾ ನಿರ್ದೇಶನಾಲಯ
भाकृअनुप - काजू अनुसंधान निदेशालय
ICAR - DIRECTORATE OF CASHEW RESEARCH
Darbe P.O., Puttur - 574 202, Dakshina Kannada, Karnataka

650

Advances in
CASHEW PRODUCTION TECHNOLOGY

21– 23 May 2015

Lecture Notes Series 24
(For circulation to participants of training programme)

ಐ.ಸಿ.ಎ.ಆರ್. – ಗೇರು ಸಂಶೋಧನಾ ನಿರ್ದೇಶನಾಲಯ
भाकृअनुप - काजू अनुसंधान निदेशालय
ICAR - DIRECTORATE OF CASHEW RESEARCH
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May 2015 **Lecture Notes Series 24**

Published by

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Director

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FOREWORD

India is the first country to exploit cashew as a commercial crop though five centuries after its introduction to India by Portuguese. Directorate of Cashew Research is the nodal agency for cashew research in the country. The research on cashew was initiated in the early 1950s and initially, Indian Council of Agricultural Research (ICAR) sanctioned *Ad-hoc* schemes in research centres of Kerala, Karnataka, Andhra Pradesh, Assam and Maharastra. This was followed by sanctioning of All India Coordinated Spices and Cashew Improvement Project at CPCRI, Kasaragod and establishment of National Research Centre for Cashew at Puttur in 1986. This centre was further upgraded to Directorate of Cashew Research (DCR) in 2009.

Considering the growing demand for cashew at both global and national levels, it is imperative to increase production and productivity of raw cashewnut, besides enhancing production of cashew apple which can be utilized for preparation of value added products. Towards achieving this, it is essential to know the current status of research and development in cashew in the country. I am pleased that Directorate of Cashew Research, Puttur in collaboration with Directorate of Cashewnut & Cocoa Development, Kochi is organizing a National Level Training Programme on "Advances in Cashew Production Technology" with special emphasis on the latest concepts, methodologies, approaches and practices in the field of cashew research for the benefit of stakeholders.

I congratulate the editors and all scientists involved in bringing out this publication and I hope it will be immensely useful to researchers, policy makers and other stakeholders who are engaged in research and development of cashew in the country.

[P.L. SAROJ]

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CASHEW CULTIVATION IN INDIA: ISSUES AND CHALLENGES

Prof. P.L. Saroj, ARS
Director
ICAR-Directorate of Cashew Research, Puttur
pl.saroj@icar.gov.in

Introduction

Though, cashew (*Anacardium occidentale* L.), is an exotic horticultural crop brought to India by Portuguese travellers in 16th Century but now adapted well in Indian conditions. It is grown along the coastal regions of Maharashtra, Goa, Karnataka and Kerala in the West Coast and Tamil Nadu, Andhra Pradesh, Odisha and West Bengal in the East Coast. It is spreading in non-traditional areas such as Bastar region of Chhattisgarh and Plain regions of Karnataka, Gujarat, Jharkhand and in NEH region. Due to its high nutritional value and increasing affordability by the consumers, demand for cashew continues to increase both in India and in foreign countries. During 2012-13, total production of cashew in the country was 7.28 lakh tonnes from 9.82 lakh ha of land with a productivity of 772 kg/ha (Fig. 1). Moreover, the productivity of cashew nut in India is very. There is a wide gap between potential productivity and present productivity. The major factors for low productivity are: the large plantations under seedling origin, poor orchard management practices and severe incidence of tea mosquito bug (TMB) and cashew stem and root borer (CSRB).

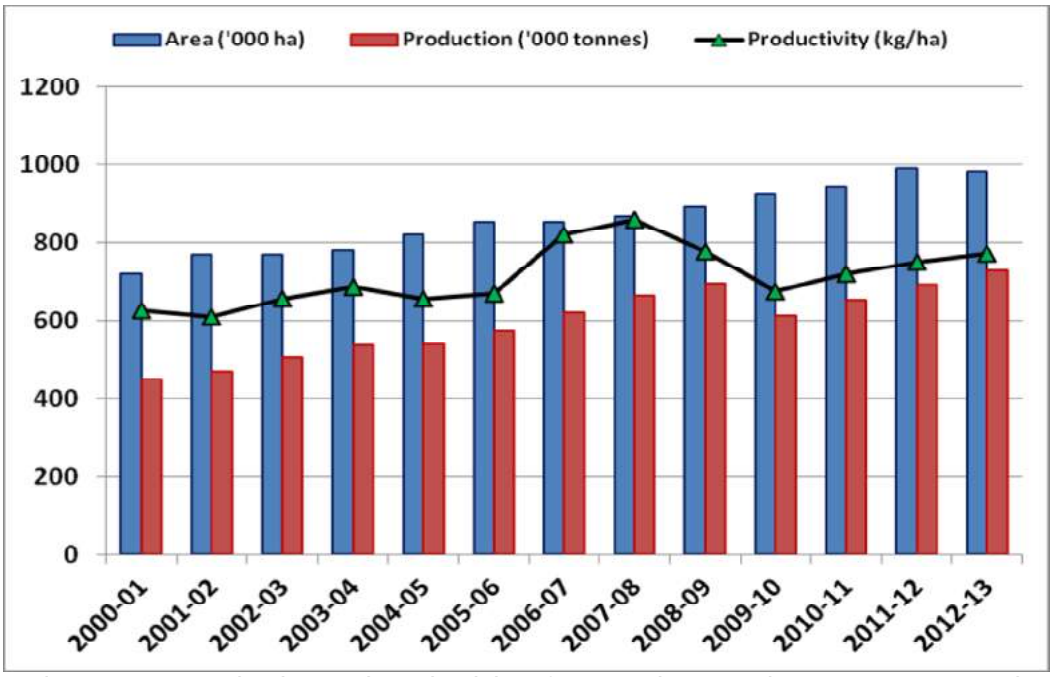

Fig. 1. Area, production and productivity of raw cashew nut (2000-01 to 2012-13)

Production system management

(i) Establishment of cashew orchard

Though, cashew is grown in almost all types of soils, it performs better in well drained, brown forest soils, red sandy loam and light coastal soil with a high water holding capacity and rich in organic matter. Cashew is a deep-rooted crop with its active roots concentrated in the first 1 m depth of the soil and 2 m radius around the trunk of the tree. Therefore, soil should be minimum 1.5 m deep without any hard pan which obstructs root growth. While selecting land for cashew, soils with salinity/ alkalinity or water logging should be avoided. The selected land should be cleared of shrubs/ vegetation before digging pits. The pits of 60 cm x 60 cm x 60 cm are to be opened at a spacing of 7.5m x 7.5m or 8m x 8m for cashew which gives a tree density of 175 and 156 trees/ha, respectively. High density planting at 4m x 4m giving a tree density of 625 trees/ha in the initial years and subsequently thinning in stages to reach a final spacing of 8m x 8m is also practiced in some areas. High density planting of cashew is more suitable in less fertile areas. The size of pits can be increased upto 1m x 1m x 1m in soils with hard pan or hard laterite substratum. Opening the pits along the contour line is preferred in slopy areas. The pits have to be filled with mixture of top soil, compost (10 kg) or poultry manure (2 kg) and rock phosphate (200 g). A small channel above the pit is opened to divert water to the sides during rainy season in slopy lands. The runoff water should not accumulate in the pit which causes water stagnation during rainy season.

Planting of grafted plants is usually carried out during the monsoon season (July-September). The polythene bag (containing graft) covering the root and soil is to be removed carefully and the graft with ball of earth intact is to be separated. The graft is to be placed gently in the centre of the pit where soil is scooped out and cover with soil and press gently. The graft is to be planted in such a way that the graft union is above the soil level. Sprouts if any below the graft union may be removed with the help of sharp knife. Plastic ribbon covering the union is removed if not done already. Mulching should be done at the base around the plant to conserve soil moisture and also to suppress weed growth. Frequent watering is required during post monsoon phase.

(ii) Selection of varieties

With the concerted efforts of DCR, Centres of AICRP-Cashew and SAUs, a total of 42 cashew varieties (29 selections and 13 hybrids) have been developed and released in the country for cultivation.The varieties released by DCR *viz*., NRCC Selection-2 and Bhaskara are medium nut types with high yield and recommended for cultivation in Karnataka. These varieties exhibited better yield performance in other cashew growing regions of the country as well. Twenty-one varieties have kernels with export grade (W 180 to W 240). The varieties recommended for adoption in different cashew growing states are given below:

State	Recommended varieties
Andhra Pradesh	BPP-4, BPP-6 and BPP-8
Goa	Goa-1, Goa-2, Vengurla-1, Vengurla-4, Vengurla-6 and Vengurla-7.
Karnataka	NRCC Sel-2, Bhaskara, Ullal-l, Ullal-3, Ullal-4, Vengurla-4, Vengurla-7, Madakkathara-2, Chintamani-1 and Chintamani-2.
Kerala	Madakkathara-I, Madakkathara-2, K-22-I, Kanaka, Dhana, Priyanka, Amrutha and VRI-3.
Maharashtra	Vengurla-l Vengurla-3, Vengurla-4, Vengurla-6, Vengurla-7 and Vengurla-8.
Odisha	Bhubaneswar-I, BPP-8 and Dhana.
Tamil Nadu	VRI-1, VRI-3 and VRI H-1
West Bengal	Jhargram-I, Bidhan Jhargram-2 and BPP-8
North Eastern States	Ullal-3, Ullal-4, Vengurla-1 and Vengurla-4

(iii) Production of Quality planting material

Being a cross pollinated crop, the seedlings raised orchards show variation with respect to yield, nut size, apple colour and several other characters. Hence, vegetative propagation is adopted in cashew as vegetatively propagated clonal progenies are genetically identical to the mother plant and give relatively more uniform yield and come to fruiting earlier. Of the different methods of vegetative propagation, softwood grafting was found to be the best for vegetative propagation of cashew. Production of planting material of high yielding varieties through softwood grafting technique has been a great success story in cashew and has made tremendous impact in improving cashew productivity. There are over 100 Regional Cashew Nurseries, which are coming under both public and private sector. Farmers are always advised to procure planting materials from accredited nurseries of recommended varieties and standard. Framers can himself produce planting materials after taking necessary training from the Directorate of Cashew research, Puttur.

(iv) Management of plant canopy architecture

Canopy management in cashew has direct impact on vigour of plants which eventually influencing yield and quality of nuts. Therefore, proper training should be done from the beginning in order to develop ideal frame work. Sprouts emerging from the rootstock are to be removed at regular intervals as and when seen. The graft should be allowed to grow by maintaining single stem up to 0.75 to 1 m height by removing sprouts or side shoots not only below the graft union (stock portion) but also above it. The flower panicles emerging later in the season need to be removed during the first two years of growth of the graft to facilitate proper vegetative growth and thereby achieving proper height and good canopy. The plants are to be allowed to flower and fruit from third year onwards. The well spaced branches (4-6) should be allowed in all directions. For better fruiting regular pruning is important based variety and vigour of plant.

(v) Rejuvenation of senile cashew orchards

In older cashew plantations, removal of dried or dead wood, criss-cross branches, water shoots etc. should be done at least once in 2-3 years. Redevelopment of canopy is possible by heading back of existing senile trees which have exhausted canopies and erratic growth resulting in reduced yield. Heading back if done at 1.0-1.5 m height of the trees new flushes will emerge from dormant buds on remaining trunk and develops into a vigorous new canopy. By and large old cashew plantations are of seedling origin and have become senile. Such trees can be rejuvenated by grafting with scion sticks of improved and high yielding varieties on new shoots arising on beheaded stumps. May-June is the right time for beheading and July-August is for grafting. However, preventative measures need to be taken to monitor each plant for the attack of cashew stem and root borer on the top worked trees.

(vi) High density planting

High density planting technique in cashew has provided higher yield and better economic returns per unit area in the initial years, but also helped more efficient use of inputs. Further, high density planting reduces the weed growth by early canopy coverage, reduces soil temperature thereby increasing the soil moisture content especially during peak summer season and provides mulching effect. In high density planting, closer spacing [6.5 m × 4 m (384 plant density/ha), 5 m × 5 m (400 plant density/ha) and 5 m × 4m (500 plant density /ha)] has given two times more yield than normal spacing. Cashew nut yield can be increased to four folds up to 6 years and 2.27 folds up to 12 years in high density planting system. High density planting system however needs suitable dwarf and / or compact cashew varieties so that overlapping of canopy is kept at minimum. High density planting with dwarf and compact canopy varieties shall be the best breeding strategy for increasing productivity of cashew per unit area. Limb pruning and diagonal thinning can also be evaluated for their effectiveness in high density planting systems.

(vii) Soil and water conservation techniques

Cashew is generally grown on degraded lands and experiences severe moisture stress from January to May, which adversely affects flowering and fruit set. In order to harvest the rainwater and to make it available to the cashew plant during critical period, *in situ* soil and water conservation techniques are very important. Studies conducted at DCR, Puttur have indicated that coconut husks buried in trenches of 1 m width 0.5 m depth and 3.5 m length per plant opened across the slope between two rows of cashew helps in better soil and water conservation. Generally three to four layers of coconut husks are buried one above the other. The first layer is laid with the convex surface of the husk touching the ground. After spreading a layer of soil on the husks, the second layer of husks is laid in the same position. The last layer should be covered with soil upto 10 cm thickness. About 100 coconut husks are needed to bury in a trench of 3.5 m length. The coconut husk buried will enhance moisture retention of soil and make the same available to the plants during flowering and fruiting, thereby reducing fruit drop. Soil moisture content was considerably higher in soil and water conservation plots as compared to control plots (without soil and water conservation measures). With proper soil and water conservation, the soil loss can be minimized;

the runoff water from post-monsoon and pre-monsoon rainfall can be harvested and made available to the plant during the critical period.

(viii) Nutrient management

In India, cashew is mainly grown on laterite, red and coastal sands. It is also grown on black soils in Tamil Nadu and Andhra Pradesh to a limited extent. Though it is grown in almost all types of soils, it performs better in well drained, brown forest soils, red sandy loam and light coastal soil with a high water holding capacity and rich in organic matter. A large portion of cashew growing soils is reported to be acidic. Some of the major constraints to cashew production on acid soils are: Low soil pH brings associated problems, including Al, and Mn toxicity, low base saturation percentage, low available P and high P fixation capacity, low concentrations of exchangeable Ca, Mg, and K, reduced Zn, Mo and B availability and low microbial activity (nitrification), sensitivity to erosion, low water holding capacity, low permeability to air, water, and roots, slow water infiltration rate *etc.*

The major nutrient requirement of cashew plant demands more liberal application of N followed by K, while P is needed in comparatively lesser quantity. Nitrogen and P are most important nutrients during the pre-bearing stage, but at the bearing stage, K together with N is also important. Studies conducted at DCR, Puttur indicated that application of 500 g N and 125 g each of P and K and 10 kg poultry manure per tree per year under normal density planting system (200 trees/ha) and 250 g N and 50 g each of P and K and 10 kg poultry manure per tree per year under high density planting system (625 trees/ha) is found superior in terms of higher nut yield for rainfed cashew. The recommended dose of fertilizers for cashew for major producing states is given in the Table 1. The recommended dose of fertilizers during first year after planting is 1/5th of the full dose, 2nd year after planting is 2/5th, 3rd year after planting is 3/5th, 4th year after planting is 4/5th and 5th year onwards is full dose. In order to enhance the efficiency, fertilizers should be applied in a circular trench of 10 cm depth at a distance of 0.5 m, 0.75 m and 1.5 m away from the centre of the trunk in the first, second and third year onwards, respectively and covered with soil. Foliar sprays of nutrients (urea 2 to 4%; DAP 1%; orthophosphoric acid; $ZnSO_4$ 4%; Cu 0.3 to 0.6%) at the emergence of the flush, panicle initiation and fruit set stages ensure better fruit set and also enhance nut yield in cashew.

Table 1. Recommended dose of Fertilizers to Cashew for different states

State	Nutrient dose for mature cashew plantations (5th year of planting) (g/tree/year)		
	N	P	K
Kerala	500 750	125 325	125 750
Karnataka	500 500	250 125	250 125
Tamil Nadu	500	200	300
Andhra Pradesh	500 1000	125 125	125 125
Maharashtra	1000	250	250
Odisha	500	250	250
West Bengal	1000	250	250

Water soluble fertilizers such as urea, DAP, and MOP were suggested for fertigation through drip once in a week from December to March. With fertigation, the quantity of nutrients (through fertilizers and organic manure) to be applied can be reduced to half the quantity of recommended nutrients. It has been reported that an increase of 100 per cent and 226 per cent in yield in treatment receiving half of recommended dose of NPK in inorganic form (Recommended dose: 500 g N, 125 g each of P_2O_5 and K_2O/tree/year) of nutrients through fertigation and balance half applied in organic form through castor cake as compared to the above dose applied through soil and irrigated separately and, absolute control (without manure and irrigation) respectively indicating better nutrient use efficiency.

Majority of the cashew growing farmers do not apply fertilizers / pesticides / fungicides due to which the productivity of cashew is moderate. Hence, there is very vast potential of bringing the areas like NEH region under organic farming to take advantage of great demand globally for organically produced cashew. Organic production of cashew offers immense potential. Cashew plantations produce huge cashew biomass which can be recycled for supply of nutrients. About 5.5 t of cashew leaf litter and cashew apple (Recyclable cashew biomass) available per ha can be converted into 3.5 t of compost or vermicompost which contributes 50 per cent of the total nutrient requirement of cashew. Growing green manure crops such as glyricidia, sesbania, sunhemp and cover crops between two rows of cashew resulted in considerable improvement in soil moisture content and soil quality. The dry matter production of green biomass was about 7.65, 5.75 2.25 and 1.63 t/ha/year from *glyricidia*, sesbania, sunhemp and cover crop, respectively. The nutrient addition to soil was about 186 kg N, 23.6 kg P and 126.2 kg K and 141 kg N, 17.9 kg P and 162.3 kg K /ha through *glyricidia* and sesbania, respectively.

(ix) Water management

Generally, Cashew is grown as a rainfed crop, but the yield can be doubled if irrigated. The largest area under cashew cultivation is along the steep hillocks of West Coast region of India where the mean annual rainfall ranges from 3000 to 3500 mm with 80% of its contribution during June to September. Due to the non-uniform distribution of rainfall, cashew experiences severe moisture stress from January to May which adversely affects its flowering and fruit set, resulting in immature nut drop and lower productivity of cashew gardens. During fruiting season of cashew (February to May), a mean rainfall of around 67 to 415 mm is received. The water deficit is highest during March to May (112 to 183 mm). Cashew yields can be enhanced by providing protective irrigation with 200 L of water per tree once in 15 days from January to March during the summer season. Irrigation can be started after the commencement of flowering for better nut set, filling and yield. It has been reported that fertigation saved 50% in the fertilizer requirement and doubled the cashew yield.

(x) Cashew based cropping systems

During the initial age (upto first 3-5 yrs), several intercrops can be taken up between two rows of cashew plants to get more returns as well as utilize the solar energy and soil resources efficiently. Pineapple can be grown as a intercrop between two rows of cashew for the first seven years. The spacing to be maintained for cashew is 8m x 8m

(156 trees/ha) or 7.5 m x 7.5 m (175 trees/ha) or 10 m x 5 m (200 trees/ha). Growing pineapple in trenches across the slope between two rows of cashew helped to conserve the soil moisture, which in turn increased the yield of cashew (main crop) by 1.5 times compared to cashew alone. Pineapple can be grown as a profitable intercrop under irrigated as well as rainfed conditions in west coast region. Other suitable intercrops are tapioca, turmeric, ginger, cucurbits, colocasia and elephant foot yam.

(xi) Pest management

A large number of insect and pests have been reported in cashew but tea mosquito bug and cashew stem and root borer are the major pests of cashew. The tea mosquito bug (TMB), *Helopeltis antonii* Sign. (Heteroptera : Miridae) is the most serious foliage and fruit pest of cashew in India. Integrated pest management involving resistance and adopting spraying of insecticide is a good package to manage TMB. Mid season variety like Bhaskara is able to escape from the severity of the pest to certain extent. As the TMB incidence coincides with critical period of flushing, flowering and fruit set, need based spray as given below has been recommended.

Flushing	-	Lambda cyhalothrin (0.003%)
Flowering	-	Carbaryl (0.1%) or lambda cyhalothrin (0.003%)
Fruiting	-	Carbaryl (0.1%)

Cashew Stem and Root Borer (*Plocaederus ferrugineus* L.) (Coleoptera: Cerambycidae) is another important pest infesting cashew in all parts of India. Integrated pest management involving phytosanitation measures is found very effective in managing CSRB. The trunk portion is to be examined at least once during fruiting season (February - May) for initial symptoms of cashew stem and root borer infestation and grubs should be removed by carefully chiseling out the bark taking care not to damage more than half of bark circumference. Swabbing the pest infested portion after removal of different stages of pest occurring internally and drenching the root zone with chlorophyriphos (0.2%) as post extraction prophylaxis (PEP). Dead trees and those beyond recovery should be uprooted and removed before and after monsoon as they serve as natural inoculum repositories for further spread of this pest. The newly planted grafts should be trained to have branching at a height of 0.75 to 1.00 m from ground level for better inspection and management operations.

(xii) Harvesting of nuts and apples

Bearing commences after the third year of planting and the trees will be in full production by the tenth year whilst the economic life of a tree is about 20 years. The main harvesting season is from February to May. Most farmers harvest their crop before they drop to prevent pilferage. This very often results in poor quality of the kernels. The optimum stage of harvest is when nuts drop to the ground. High quality nuts are obtained when freshly fallen nuts are separated from the cashew apples and sun dried for 2-3 days to bring down the moisture percentage from about 25 per cent to below 9 per cent. It is very essential to dry the nuts in order to prevent spoilage during storage. The drying process helps to retain flavor and quality of the kernels. When cashew apples are used for processing, harvesting has to be carried out before they drop. A simple test of maturity is to float nuts in water when mature nuts will sink

while the immature and unfilled nuts will float. Nuts are usually gathered every week during the harvest season. Ripe cashew apples for the fresh fruit should be harvested daily before they drop of on ground.

MAJOR ISSUES AND CHALLENGES

Researchable issues

Genetic Resource Management:

i) Narrow genetic base.
ii) Introduction of germplasm with desired traits.
iii) Cryo-preservation of germplasm.

Crop Improvement:

i) Development of dwarf genotypes with high yield potential suitable for high density planting.
ii) Varieties for cold tolerance, variable CNSL content, cashew apple, early maturing varieties. for NEH region and nutrient efficient varieties with synchronized flowering and fruiting.
iii) Development of SSR markers.
iv) Linkage mapping to identify markers linked to economic traits.
v) Introgression of genes from wild species.

Crop Management:

i) GIS based delineation of cashew area.
ii) Variety and location specific management.
iii) Development of nutrient diagnostic norms.
iv) Input use efficiency.
v) Foliar feeding and use of growth regulators.
vi) Management of canopy architecture.
vii) Identification of rootstock.
viii) Cashew based cropping systems.
ix) Better understanding of crop phenology.
x) Farm mechanization.

Crop Protection:

i) Development of pheromone and kairomone traps.
ii) Utilization of entomopathogenic nematode (EPN) for management of cashew stem and root borers (CSRB) and fungal pathogens for tea mosquito bug (TMB).
iii) Development of pest forecasting models.
iv) Evaluation of new and safer molecules for management of pests.
v) Economic threshold level for foliage pests.
vi) Monitoring pests and disease dynamics in the scenario of climate change.

Post – Harvest Technology:

i) Efficient mechanization of cashew processing.
ii) Development of standards for raw cashewnuts.
iii) By-product utilization.
iv) Product diversification.
v) Non-thermal processing of cashew (cold).

Transfer of Technology and HRD:

i) Constraint analysis in technology adoption.
ii) ICT based TOT.
iii) Crop advisory system.
iv) Human Resource Development.

Policy Issues:

i) Poor coordination between research and development agencies.
ii) Reliable data base.
iii) Crop insurance.
iv) Minimum support price.

CHALLENGES

Genetic Resources:

i) *In vitro* clonal regeneration.

Crop Improvement:

i) Development of varieties resistant to CSRB and TMB.
ii) Breaking the yield barrier.

Crop Management:

i) Enhancement of cashew productivity.
ii) Expansion of area under moderate cold climate.
iii) Organic production of cashew.
iv) Sustained supply of raw cashew nuts to industries.

Crop Protection:

i) Eco-friendly and cost effective management of CSRB and TMB.
ii) Early detection of CSRB infestation.

Post-Harvest Technology:

i) Automation of cashew processing.
ii) Commercialization of cashew apple based value products.

BIODIVERSITY, VARIETAL WEALTH AND MOLECULAR APPLICATIONS IN CASHEW

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Introduction

Biodiversity is the universal phenomenon and is essential for existence of life on earth. This forms the fundamental link between the need for conservation and utilization of genetic resources, and sustainable production programmes or strategies. Increasing awareness about the importance of crop diversity and its conservation world wide for posterity has led to formulate the strategy for global food security. In this context, Cashew is being viewed as one of the most potential tropical nut tree that caters to the needs of the nutritional security as well as economic security in the global scenario in general and for the cashew growing countries in particular considering all the global stakeholders involved in the global cashew platform. Therefore, cashew genetic resources assume greater significance especially in the current context when there increasing demand for cashew nuts at national and international level. The cashew tree occupies an important position among the tropical nut and fruit bearingtrees on account of the growing commercialization of its main economic products: the nut, the cashew 'apple' and cashew nut shell liquid (CNSL). This crop with its inherent potential features to support the man's needs for the long future. Cashew has abundant diversity of unique kind which deserves to be conserved diligently. After realizing its economic potential and nutritional importance, all cashew growing countries have initiated several research programmes on cashew including the studies on diversity and its utilization cashew crop improvement for evolving new varieties or genotypes with due focus on climate change factor. Several new varieties have been already developed and yet the crop improvement is continued to address the new challenges of biotic and abiotic nature. Novel approaches like molecular breeding strategies are being integrated in identifying, selecting and enhancing and exploring the genetic potential of this crop. Some aspects in this direction are summarized here under just to recapitulate the status of the crop improvement in cashew utilizing its genetic resources.

Diversity in cashew

The greatest diversity is reported to exist in the Various coastal ecosystems comprising of beach and dune vegetation and the restinga in northeastern Brazil. However, with spread of this nut to the Asian and African continents and the subsequent realization of economic value of cashew kernels in the new world, commercial plantations were taken up, though primitive in nature, in the early part of 20th century. As usual, seed nuts selected from better yielding trees led to the establishment of Easter year's commercial plantations of seedling progeny. Due to high heterozygosity coupled with allogamous nature of cashew species, the above, preliminary plantations had segregated seedling progeny with enormous variability with respect to yield, nut size and quality , apple size and quality, growth habit, etc. As a result, there existed some natural recombinants having some desired high yielding traits in them which were picked up or identified as plus trees. Thus, development of high yielding

varieties initially started with identification of superior genotypes from among the existing seedling population. Initially selection of high yielding elite trees among the seedling progeny was irrespective of nut quality. The elite selections having high yielding traits were released as varieties, vegetatively propagated (by layering, budding or grafting) and supplied for commercial planting.

Cashew Germplasm

The main goals of the cashew germplasm bank is to document and conserve plant material, which can then be used to enrich the available genetic variation in the species, serve as a basis for agronomic and morphological characterizations of accessions, and support breeding programs.

Castro (2011) reports that the cashew germplasm bank located in Pacajus, Ceará State, Brazil, holds 621 accessions, most of which belong to *Anacardium occidentale*. The accessions are characterized with morphological, agronomic and molecular descriptors. The genetic variability contained in the collection has allowed development of early dwarf cashew clones, recommended for commercial planting in northeastern Brazil. The genetic basis of early dwarf cashew has been expanded by natural and artificial hybridization with regular cashew genotypes from the germplasm bank, to increase the weight and size of nut and kernel. Interspecific hybrids of *A. occidentale* × *A. othonianum* and *A. occidentale* × *A. microcarpum* have been produced in order to transfer anthracnose resistance alleles and desired quality traits to table cashew.

Recapitulated objectives for crop improvement in cashew

The breeding objectives broadly aimed at developing new high yielding commercial varieties with such characters as desired tree size (dwarf / semi dwarf canopy/ vigorous), bold nut size (>8g) with higher shelling percentage(>28%) and higher kernel grade (180-210W), bigger and juicy apple, resistance / tolerance to biotic (Cashew stem and root borer and Tea mosquito bug; Powdery mildew disease.) and abiotic stress (moisture stress and climate changes), besides considering the specific problems or needs (Bhaskara Rao, 1998., Bhaskara Rao *et al*., 1998 and Harries, *et al*., 1998).

Global crop improvement efforts in major cashew countries were reoriented keeping in view the global requirement and the constraints being faced by the respective countries, the results and achievements of which are summarized here under.

Crop improvement in India

Initially selection of high yielding elite trees among the seedling progeny was irrespective of nut quality. Redefined objectives of crop improvement in cashew to include nut quality, tree size, coupled with reaction to biotic and abiotic stress, besides higher yields, aptly hinted the importance of germplasm, variability and its eventual utility in synthesizing new varieties. (Gunjate and Deshpande, 1994; Bhaskara Rao, 1998). As genetic resources of cashew are considered as an important asset for the future, further studies on genetic divergence were undertaken in cashew (Lenka *et. al*., 1999; Sankaranarayanan and Ahmad Shah,1999; Rao *et al*., 2002). Classification of cashew germplasm accessions based on the morphological

characteristics of trees was attempted to understand the strength of genetic base of this local germplasm of Goa (Desai *et al.*, 2000).

Cashew genetic resources are conserved in field gene banks established at different centres in India. At National Cashew Field Gene Bank (NCFGB), Directorate of Cashew Research, Puttur, Karnataka, 527 cashew germplasm collections are being conserved (DCR, 2013-14), while a total of 1307 germplasm collections are being maintained at different Regional Cashew Field Gene Banks (RCFGBs) with 132 accessions at Bapatla, 100 at Bhubaneshwar, 120 at Jhargram, 208 at Vridhachalam on East Coast; 132 at Madakkathara, 43 at Pilicode, 302 at Vengurla, 75 at ICAR Goa on West Coast and 128 at Chintamani, 67 at Jagadalpur in Maidan (Plain) tracts (AICRP, 2013-14). The germplasm collections maintained at ICAR Complex for Goa include 38 bold nut types, 12 medium nut and high yielders, 20 high yielders with cluster bearing and 3 dwarf canopy types.

There are 49 cashew varieties developed in India, comprising of 30 developed through direct selection and evaluation of plus trees and 19 varieties developed through hybridization and selection, at various cashew research stations. Specialty genotypes such as dwarf types viz. TBP-1 and GB-2; Mridula (PTR-1), KGN-1 have also been identified from the among the genetic resources, which are useful in future breeding programmes.

Table 1. Characteristic features of cashew varieties developed through direct selection selections

Sl. No	Variety	Pedigree	Institute		Year	Nut yield (kg/tree)	Nut wt. (g)	Kernel wt(g)	Shelling (%)	Export grade	Apple wt. (g)	Apple colour	Juice %	Juice TSS (B^{o})	Season
1	ANK-1	T.No. 139 Bapatla	C.R.S, Anakkayam, KAU		1982	12.0	5.95	1.67	27.99	W280		Pinkis yellow	71		Early
2	MDK-1	T.No. 39 Bapatla	C.R.S, Madakkathara, KAU		1990	13.8	6.2	1.64	26.8	W280		Yellow	72		Early
3	Sulabha	K 10-2 Seln	,, ,,		1996	21.9	9.8	2.88	29.4	W210		Pinkish yellow	70		Mid season
4	MDK-2	NDR-2-1, Neduvellur	,, ,,		1990	17.0	7.25	1.88	26.00	W210		Red	68		Late
5	K 22-1	Kottarakkar 22	,, ,,		1987	13.2	6.20	1.60	26.50	W280		Red	67.5		Mid season
6	Vengurla-1	Ansur-1	RFRS, Vengural, Dr.BSKKV, Dapoli		1974	19.0	6.20	1.39	31.00	W240		Yellow	65		Early
7	Vengurla-2	WBDC-VI (V.37/3)	,, ,,		1979	24.0	4.30	1.00	32.00	W320		Red	45		Early
8	BPP-3	3/3 Simhachalam	CRS, DR YRS APHU, Bapatla		1980	11.0	4.80	1.34	28.10	W400		Yellow	67		Late
9	BPP-4	9/8 Epurpalam	,, ,,		1980	10.5	6.00	1.15	23.00	W400		Yellow	64		Late
10	BPP-5	T.No.1	,, ,,		1980	11.0	5.20	1.25	24.00	W400		Yellow	64		Early
11	BPP-6	T.No.56	,, ,,		1980	10.5	5.2	1.44	24.00	W400		Yellow	74		Early-mid season
12	VRI-1 (M10/4)	Vazhisodanipalyam local	RRS, Vridhchalam, TNAU		1981	7.20	5.00	1.40	28.00	W320		Yellow	74		Mid-late
13	VRI-2 (M 44/3)	T1668 Kattrapalli	,, ,,		1985	7.4	5.10	1.45	28.30	W320		Yellow	82		Mid-late
14	VRI-3 (M26/2)	EDayanchavadi	,, ,,		1991	11.68	7.18	2.16	29.10	W210		Red	72		Mid-late
15	Ulla-1	Taliparamba			1984	16.0	6.70	2.05	30.70	W210		Yellow	64.2		Mid-late
16	Ullal-2	36/67 Gumtur	,, ,,		1984	9.00	6.00	1.83	30.50	W320		Red	64		Mid season
17	Ullal-3	5/37 Manchery	,, ,,		1993	14.70	7.00	2.10	30.00	W210		Dark Red	66		Mid season
18	Ullal-4	2/27 Tuni-AP	,, ,,		1994	9.50	7.20	2.15	31.00	W210		Yellow	65.4		Early-Mid season
19	Chintamani-1	8/46 Taliparamba	,, ,,		1993	7.20	6.90	2.10	31.00	W210		Yellowish red	65.4		Mid-late
20	UN-50	2/27 Nileshwar	,, ,,		1995	10.50	9.00	2.24	32.80	W180		Yellow	65.2		Mid-late
21	NRCC-1	3/28 Simhachalam			1989	10.00	7.60	2.10	28.80	W210		Yellow			Late

22	NRCC-2	2/9 Dicherla	,, ,,		1989	9.00	9.20	2.15	28.60	W210		Pink			Mid season
23	Bhaskara	Goa 11/6	,, ,,		2006	10.7	7.38	2.20	30.60	W240					Mid season
24	Jhargram-1	T 16 Bapatla	BCKV, Kalyani		1989	8.50	5.00	1.50	30.00	W320		Yellow	63.5		Late
25	Bidhan Jhargram-2	H-2/15	,, ,,		2013	8.0	9.2	2.85	32.0	W180		Yellow			
26	Bhubaneshwar-1	WBDC-5 (V36/3)	OUAT, Bhubaneshwar		1989	10.00	4.60	1.47	302.00	W320		Reddish yellow			Late
27	Jangannatha	BH-6	,,			10.5	8.6			32.5					Mid
28	Balabhadra	BH-85	,,			10.0	7.4			30.0					Early
29	Goa-1	Balli-2 Accession	ICAR Complex, Goa		1999	10.00	7.60	2.20	30.00	W210	70.0	Yellow	68	11.2	Mid season
30	Goa Cashew -2	Tiswadi-3	,,		2007	7.5	9.8	2.6	29.6	W180	110	Yellowish orange	69.5	108	Early

Table 2 . Characteristic features of cashew varieties developed through hybridization.

Sl. No	Variety	Pedigree	Institute		Year	Nut yield (kg/tree)	Nut wt. (g)	Kernel wt(g)	Shelling (%)	Export grade	Apple wt. (g)	Apple colour	Juice %	Juice TSS (B^o)	Season
1	Dharasree (H 3-17)	T-30 x Brazil 18	CRS, KAU.		1996	15.02	7.80	2.40	30.50	W240		Yellowish pink	67		Mid season
2	Anagha (H 8-1)	T-20 x K-30-1	,, ,,		1998	13.73	10.00	2.90	29.00	W180		Orange red	66		Mid season
3	Priyanka (H 1591)	BLA 139-1 x K-30-1	,, ,,		1995	17.03	10.80	2.87	26.57	W180		Yellowish red	67		Mid season
4	Vengurla-3	Ansur-1 x Vettore 56	RFRS, Vengurla,		1981	14.40	9.10	2.09	27.00	W210		Yellow	77		Mid season
5	Vengurla-4	Midnapur red x Vettore 56	,, ,,		1981	17.20	7.70	1.91	31.00	W210		Red	76		Early
6	Vengurla-5	Anasur early x Mysore Kotekar1/61	,, ,,		1984	16.60	4.50	1.00	30.00	W400		Yellow	86		Mid season
7	Vengurla-6	Vettore 56 x Anasur-1	,, ,,		1991	13.80	8.00	1.91	28.00	W210		Yellow	85		Mid season
8	Vengurla-7	Vengural-3 x VRI-1	,, ,,		1997	18.50	10.00	2.90	30.50	W180		Yellow	86		Mid season
9	Vengurla-8	Vengurla-4 x (VRI-1)	,, ,,		2001	15.75	11.50	2.80	28.0	W180		Red			Mid season
10	BPP-1	T 1 x T 273	CRS, Bapatla,		1980	10.00	5.00	1.75	27.50	W400		Yellow	68		Late
11	BPP-2	T 1 x T 273	,, ,,		1980	11.00	4.00	1.04	25.70	W450		Yellow	67		Late
12	BPP-8	T 1 x T 39	,, ,,		1993	14.50	8.200	1.89	29.00	W210		Yellow	64		Early
13	Kanaka (H 1598)	BLA 139-1 x H 3-13	,, ,,		1993	12.80	6.80	2.08	30.58	W280		Yellow	70		Mid season
14	Dhana (H 1608)	ALGD-1 x K 30-1	,, ,,		1993	10.66	8.20	2.44	29.80	W210		Yellow	72		Mid season
15	Amrutha (H1597)	BLA 139-1 x H 3-13	,, ,,		1998	18.35	7.18	2.24	31.58	W210		Yellow	72.2		Mid season
16	Akshaya (H 7-6)	H-4-7 x K 30-1	,, ,,		1998	11.78	11.00	3.12	28.36	W180		Yellow	68		Mid season
17	Raghava (H 1610)	ALGD-1 x K 30-1	,, ,,		2002	14.65	9.20	2.27	26.60	W210		Yellow	68		Mid season
18	Damodara (H-1600)	BLA 139-1 x H 3-13	,, ,,		2002	13.65	8.20	2.00	27.27	W240		Red	68		Mid season
19	Poornima	BLA 139-1 x K30-1	,, ,,		2006	14.08	7.80	2.60	31.00	W210			75.3	13.3	Mid season

Comparative analysis of varieties developed in different countries reveals that research programmes are taken up with divers objectives, considering the local constraints and needs, however, with common major emphasis on nut yield and quality. Comparative information present in Table 3. It is observed that, varieties with extremely high yielding ability are developed elsewhere in different countries, particularly in Tanzania.

Table 3. Comparison of varieties of major cashew growing countries

	India	Brazil	Tanzania	Vietnam
Nut yield (Kg/tree)	Var:7.2(Vri-1) - 24(Veng-2) Hyb:10(BPP1 – 18.5 (Veng-7)	Normal : 1 -180 Hyb. 25 (Emb.50)	Var: 50- 92 (18 yrs)* Hyb:115-140 (18yrs)	7.4-10.2 (at 3 yrs age)
Nut size (g)	Var.:4.3 (Veng3) - 9.0 (UN-50) Hyb:4.5(Veng-5) - 11.5(V-8)	4.8 – 12.2	6.1 (Ac 6) - 10 (AC4)	6.21 – 7.14
No. nuts/kg	Var: 230 – 110 Hyb: 220 - 90	220 - 85	100 - 164	161 - 140
Kernel out turn (%)	Var:26.0(Mdk-2 – 32.8(UN-50) Hyb:25.7(BPP-2)-31.8(Amruta)	26-32	27 - 33	28.8 – 31.4
Resistance / tolerance to disease / insect	Few Mod. Tolerant to TMB Susceptible for CSRB No screening for diseases	Resistant to Gumosis Anthracnose	Tol. to PM, Anhrac, Die back Res. to	Need protection from TMB & Anthracnose

Crop improvement results at Goa Centre.

Besides Goa-1 (Balli-2) cashew variety developed through selection and clonal evaluation, a long-term evaluation trial of local bold nut accessions resulted in the selection of three more promising genotypes namely, Tiswadi-3, Ganje-2 and KN 2/98. Tiswadi-3 is already approved for releasing under the name Goa-2. It is a jumbo nut (9.2-10.6g) selection with bigger apple (101-110g) and higher juice contents. This selection is early and yields about 10kg of nuts per tree

Table-4. Characteristic features of Tiswadi-3 (Goa-2)

	Growth and flowering	
1.	Tree Height (at 10th year)	5.8 m
2	No. fl. laterals/ M^2 canopy	18.86
3	Sex ratio (male to female)	11.54 : 1
4	Season of flowering	Dec – Mid February
5	Duration of flowering	70 – 80 days
6	Season of Harvest Nut yield	Mid Feb. – April 10.02 kg/tree
	Nut Characteristics	
7	Nut Weight.	9.2 - 10.6 g
8	Number of Nuts / kg	105 – 110
9	Shelling Percentage	29.25 to 29.55 %
10	Average Kernel weight	2.26 - 2.52 g
11	Whole Kernel Counts per lb	W 180 – W 210
	Apple Characteristics	
12	Apple Colour	Yellowish orange
13	Apple Shape	Cylindrical
14	Weight of apple	100.5 – 110 g
15	Juice Contents	68.2 – 72.0 %
16	TSS contents	10.8 – 12.2 ^{O} B

Figure 4. Apple, nut and kernels of Tis-3 selection

Promising New Selections:

Ganje-2 (GCC 94/2) and KN-2/98 (G-CS-7-7) are the other two promising selections from the local germplasm, which are in the pipeline for releasing for commercial cultivation in the state of Goa (Desai et al., 2010). Both are selected for their bunch bearing habit with higher nut yield of 12-14kg/tree. Ganj-2 has the vigorous tree growth with spreading growth habit. Nuts are bold (7.8-8.2g) and recorded a higher kernel recovery of 29.8 %. Round yellow apples are big (85-92.5g) with higher juice contents of 75-78 %. Trees flower during December –January with 70-80 days of flowering duration. The flowering intensity is very high (80.23 %).

Figure 5. Fruit bunch, apples and nuts of Selection Ganje-2

On the other hand, KN-2/98 has the semi-vigorous growth habit with upright and compact canopy. It is a mid season variety with flowering intensity of 80.23%. This selection bears bold nuts (8.0-8.3g) in bunch. Nuts yield kernel recovery of 29.59 % having kernel grades of W210-W240 counts. Pyriform apples are red and big (120g) with higher apple to nut ratio of 15.

Figure 6. Apple, nut and kernels of Selection KN-2/98

Brazil

The variability in Brazilian cashew is mainly viewed into two major types, the common type with a vigourous growth habit with tree height of 8-15 m, canopy diameter reaching 20 m and with a vast yield range of 1-180 kg/tree of raw nut; the dwarf type is characterized by precocious nature (flowering between 6 - 18 months after planting) short stature of tree with tree height up to 4 m, having a homogeneous canopy, with stem diameter and canopy diameter smaller than the common type. Diallel analysis to evaluate inter-populational cashew hybrids was studied by Cavalcanti, et al. (2000), The dwarf group of clones (CCP06, CCP76, CCP09, and CCP1001) and common cashew genotypes (CP07, CP12, CP77, CP96 and BTON) were used in the study. It was observed that parent effects and heterosis were components of the means of the population for important traits studied. Hybrid combinations CCP76 x CP07, CCP09 x BTON, and CCP09 x CP77 were considered as the most promising, enabling establishment of base populations for breeding programmes of cashew. This intergroup population may also useful in molecular analysis and molecular breeding.

Genetic parameters were estimated using in an interpopulation hybrids of cashew using REML/BLUP methods for vegetative, yield and nut quality traits. The study indicated that plant height, canopy diameter, kernel weight and nut weight were under strong additive genetic control thereby not expressing heterosis. The heritability of nut number and yield were higher in the broad than in the narrow sense. This indicated dominance and heterosis of these traits could be adequately exploited in cashew breeding programs. Therefore, the best-suited breeding strategy to exploit heterosis is reciprocal recurrent selection using individual crosses between parents with high mean genotypic performance and high specific combining ability. (Cavalcanti, et al.,2007).

Cashew dwarf clones, in Brazil, like CPC 06, CPC 09, CPC 76 and CPC 1001 are the phenotypic selections from natural populations of the Brazilian Northeast coastal region. Use of these in different breeding procedures such as the poly-cross method, selection between and within progenies and inter and intra-specific hybridization, resulted in the development of dwarf cashew clones Embrapa 50, Embrapa 51, BRS 189, BRS 226 and 265. Further, Embrapa Tropical Agro industry launched two new clones: BRS 274, the first clone of common cashew for commercial planting, and BRS 275, the first hybrid cashew clone, obtained from a cross between common cashew and dwarf cashew clone (CPC 1001). BRS 274 was obtained through phenotypic selection of a mother plant of common (giant) cashew in a segregating population, followed by cloning. On the other hand, BRS 275 was obtained through phenotypic individual selection within a controlled pollination progeny from a cross between a dwarf early cashew clone CCP1001 and a common (giant) clone CP 12 (Oliveira, 2008).

East and West African countries

The commercial cultivation actually started in 1950s at Iwo in Nigeria. Attempts by Cocoa Research Institute of Nigeria (CRIN) on Cashew Germplasm collections in Nigeria were initiated from 1972 based on the biotypes / land races originated from the initial introductions by Portuguese during 16th century (Sanwo, et al, 1972, Sanwo, 1973 and Hammed, *et al*.,2008). CRIN ha its field gene banks located at Ibadan (Western Nigeria), Uhonmora (Mid-Eastern Nigeria) and Ochaja (North Central Nigeria) whose collection was later found to be of narrow genetic base (Aliyu, and Awopetu, , 2007a and Aliyu, and

Awopetu, 2007b) and efforts were initiated to introduce the genetic material during 1978-1980 from India, Tanzania, and Mozambique which formed the second collection of germplasm in Nigeria. From this, twenty five half sib genotypes with high yielding potential (>1000 kg/ha) were released as G-series improved varieties by CRIN (Akinwale and Esan, 1989) . The third set of germplasm comprised of the material with characteristic bold nuts and high grade kernels, introduced directly from Brazil (by a private Company)during latter part of 1980.

Nigerian cashew plantations are comprised of six biotypes viz. Jumbo (16g), Extra large (12-15g), large (8-11g), medium (6-7g), small (2-5g) and madras (2g) with nut yield of jumbo nut types in the range of 8-10kg/tree, while the nut yield from equally matured tree of Medium and madras types in the range of 30 kg/tree to 250 kg/tree. Considering the low pricing in the international market for Medium nut size yielding kernels of W320-W280 grades, these types need to be replaced with high priced Brazilian cashew biotypes (W180-W210). About 59 accessions (11 from old land races, 23 from Indian source and 25 from Brazilian introductions are being extensively studied and used in recurrent breeding programmes in Nigeria to improve low nut yield of jumbo nut types (Hammed, *et al*.,2008). CRIN has developed an improved variety of cashew called “Brazilian Jumbo”, which has precocious bearing compared to the local varieties which mature after 5 years, besides, the higher in quality of CNSL oil.

Tanzania cashew breeding programme

The abandoned cashew farms were the inoculums source for insect pests and diseases, which resulted into an outbreak of cashew powdery mildew disease (PMD) and sucking pests (Topper *et al.* 1998)in Tanzania. The PMD is currently the main constrain in cashew production. Cashew Production Improvement Pilot Project (CPIPP) and later Cashew Improvement Programme (CIP) steadily recovered production levels from 1990s onwards. The Cashew Research Program (CRP) receives its funds from Cashew Levy (1% FOB) through Cashew Board of Tanzania/Cashew Industry Development Trust Fund, the Government of Tanzania and as well as from other sources. Under this programme, studies on genetic divergence were undertaken in cashew in Tanzania. Screening of cashew clones for reaction to *Helopeltis* was undertaken as a part of crop improvement (Millanzi,1998) Cashew breeding department at Naliendele Agricultural Research Institute in Mtwara, Tanzania has come out with several high yielding hybrids with yield potential of 24 - 100kg/tree at the age of six years without irrigation (Masawe , 1998, Masawe *et. al*., 1999 and Masawe, 2006). Following are the major tasks of cashew breeding (CIP).

- Import of additional exotic cashew germplasm from Brazil, Mozambique, Zambia, Malawi, Senegal, Cook Island.
- Release of 20 improved cashew clones, which are being distributed to farmers.
- Establishment of the controlled hand pollination techniques.
- Develop over 100 cashew hybrids, have improved cashew genetic pool.
- Develop and establishment of additional selection criteria in cashew (i.e. yield per canopy ground cover area, precocity, short duration of nut picking etc.)
- Develop and establishment of detailed flowering biology of a cashew tree.
- Establishment of existence of Genotype Environment Interaction in cashew.
- Establishment of presence of maternal effects in cashew suggesting the choice of parents to be punt into consideration.

- Establishment of the presence of clonal resistance/tolerance to sucking pests (*Helopeltis* spp). Investigation into the percentage out-crossing in cashew which has led to an establishment of the first polyclonal seed orchard in Africa.
- Identification of resistance aspects of cashew against PMD.
- Develop an effective field and laboratory based screening techniques of cashew against PMD.

Table 5. Raw nut production trend (Kg/tree) of selected cashew clones of Tanzania under CIP, under no irrigation or no fertilizer application conditions

Cashew Clone	Age of tree (Years)															Reaction to diseases & pest
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
AC 1	9	10	25	24	32	34	36	33	37	36	35	32				Partially resistant to Powdery mildew (*Oidium anacardii),* Anthracnose (*Colletotrichum gloeosporioides*), Die back (*Phomopsis) and Susceptible to* leaf and nut blight disease (*Cryptosporiopsis spp*)
AC 4	11	9	27	22	43	37	67	61	61	65	69	50				
AC 6	9	19	20	28	30	41	48	53	59	42	55	58				
AC 10	4	8	13	10	25	20	42	42	52	34	42	40				
AC 10/129									14	25	47	50	67	81	92	
AC 10/220									26	29	40	51	56	58	62	
AC 22	9	8	16	19	29	39	28	36	33	36	39	40				
AC 28	8	10	21	27	31	40	39	30	37	39	42	42				
AC 34							30	40	44	42	44	46	48	50	55	
AC 43	8	18	13	25	24	33	31	56	63	66	68	67				
AC10/14									26	29	30	39	42	48	55	
AZA 2	5	13	20	15	32	49	41	45	54	50	52	51				Resistan to leaf and nut blight disease (*Cryptosporiopsis spp*) besides above partial resistance
AZA 17/158	4	9	12	13	14	15										
AZA 17/79	4	7	10	14	16	17										

Planted at 12m x 12m or 12m x 15m spacing

Under Cashew Research Programme, Naliendele Agricultural Research Institute has developed more 20 cashew varieties of high nut yield potential coupled with partially resistance / tolerance to pest and diseases (Masawe, 2006**).** Nut yield record of a few selected clones is presented in table 5. These selected cashew clones were developed by adopting the strategy of poly clonal seed gardens

The Cashew Research Programme has been collaborating with various institutes overseas including KARI (Kenya), IIAM and INCAJU (Mozambique), NaFORRI (Uganda), FOFIFA Madagascar, OCFCU (Ethiopia), CNRA (Ivory Coast), Burkina Faso and CATAS (China).Selection of elite cashew genetic material in Mozambique was also initiated. With objective of developing dwarf, high yielding , bold nut genotypes coupled with resistance to powdery mildew and TMB, Prasad et al (2000) studied / evaluated the segregating seed progenies of the three Brazilian dwarf cashew varieties namely CP9, CP76 and CP1001and another Brazilian genotype of unknown origin. From this progeny, 32 trees were selected and further their clonal performance was evaluated. The clones of CP 1001 – V.12, AD-IV.1,

CP 76 – II.3 and CP9 – XII.8 showed high level of resistance to tolerance with very low incidence of disease coupled with higher nut yield.

Specifically dwarf and common cashew genotypes were screened separately for resistance against anthracnose (*Colletotrichum gloeosporioides*) with a view to utilize the resistant / tolerant source in cashew breeding programmes in Mozambique (Uaciquete,et al., 2013) . Not a single clone with a high level of resistance was identified out of 229 entries. However, the clones namely, 1.12PA, 12.8PA and 1.18PA were reported as tolerant types and 11.9PA and 2.3BG as susceptible types among the dwarfs. Among the common genotypes, clones NA7, MB77, 1.5R and MCH-2 ranked tolerant and IM1 and MU3 susceptible. Tolerant clones were therefore recommended to be used in the national cashew breeding program for further development of cashew cultivars with durable resistance to anthracnose.

There are two main varieties of cashew in Guinea-Bissau, the red (local) and yellow (Mozambican type. Thus, cashew industry of Guinea-Bissau till 2004 had a very small nut size types(average nut weight of 4.84g or 207 nuts per kg) with low yields, no germplasm collections due to weak applied research capacity and poor extensions capacity, public or private. But, Guinean cashew have the reputation of being sweet in flavour and having a high kernel:shell ratio, i.e. out turn rate(Lynn and Jaeger, 2004).

Vietnam

In Vietnam, high yielding clones namely DDH 66-14, DDH 67-15, B01, PN1, KP11 and BD 01 were released initially for commercial cultivation. Further, PN-1, LG-1, MH 5/4, MH 4/5 and TL-2/11 (Table 5) are the improved hybrids currently available for commercial cultivation in Vietnam (Sasi Varma, 2007).

Table 6 . Salient features of improved cashew hybrid cultivars of Vietnam (at 3 years of age)

Cultivar	Nut yield (Kg/tree)	Number of nuts./kg	Nut size (g)	Kernel out turn (%)
TL 2/11	10.2	140.0	7.14	28.8
MH 4/5	9.7	153.3	6.52	30.2
MH 5/4	8.1	135.3	7.39	30.3
PN-1	7.4	150.0	6.67	31.4
LG-1	9.1	136.7	7.31	29.1
CH-1	9.9	161.0	6.21	28.9
Mean performance	9.06	146.05	6.84	29.78

Constraints in cashew in Vietnam

Pests and diseases: Anthracnose (*Colletotrichum gloeosporioides*) is a common and serious disease of cashew. Water-soaked lesion develops on affected shoots, inflorescence and fruits, resulting in dieback and finally death of the whole tree. Fungicide sprays can be used as a control. Major insect pests include an East African weevil (*Mecocorynus loripes*) the larvae of which make extensive tunnels in the trees, an Indian weevil (*Plocaederus ferrugineus*) with wood-boring grubs, and a Brazilian butterfly (*Anthustarcha binocularis*) with larvae boring into young twigs and inflorescence. General control measures include plant and plantation sanitation and the use of insect repellents and insecticides.

Shoot borer (*Zeuzera coffeae*) is the most serious pest of cashew trees. Control measures applied for pests and diseases were practiced only in 2.17% of orchards.

In Sri Lanka, Six promising accessions namely, WUCC 05, WUCC 08, WUCC 09, WUCC 13, WUCC 19 and WUCC 21 were identified for their nut yield potential of over 15 kg/tree/year. These accessions showed high yielding ability at early stages of life cycle with high quality nut and kernel characters (Jayasekera, et al., 2009 ; Attanayaka and Jayasekera, 2011).

Resistance breeding

Screening for Anthracnose disease

In a study, 229 dwarf and common cashew (*Anacardium occidentale*) genotypes were screened for resistance against anthracnose (*Colletotrichum gloeosporioides*) in Mozambique (Uaciquete, et al, 2013). Hierarchically clonal sensitivity ranked clones 1.12PA, 12.8PA and 1.18PA as tolerant and 11.9PA and 2.3BG as susceptible among the dwarfs. Among the common genotypes, clones NA7, MB77, 1.5R and MCH-2 ranked tolerant and IM1 and MU3 susceptible. Tolerant clones were therefore recommended for using in the national cashew breeding program for further development of cashew cultivars with durable resistance to anthracnose. Clones such as 2.5VM, 1EM, MB75 and others that revealed incidence consistency over seasons can be used as susceptibility or tolerance standards in screening trials.

Molecular Markers in cashew

DNA markers are fundamental links between plant breeding and plant biology. Hither to, approaches for crop improvement were mostly accomplished in the total absence of basic knowledge of plant biology. Still many important biological phenomena like heterosis, epistasis, host-pest interactions, response to abiotic stress, *etc*, very often used in plant breeding programmes, are described in abstract concepts. But there is a need to generate precise and firm data for complete understanding of genetic gains in perennial crops like cashew. Knowledge on basic biology, therefore, will be the source for much new information about genomes, genes, pathways and interactions of direct relevance to crop improvement. In many instances, DNA markers will be the vital and fundamental link between plant biology and main stream plant breeding. Several reports are available depicting the efforts to generate molecular data base in cashew to understand the diversity, selection of parental combinations for hybridization for constructing desired recombinants, marker assisted selection and QTL mapping, etc., in order to enhance the precision and pace of crop improvement in cashew.

For the first time, RAPD markers were used in cashew to distinguish four dwarf cashew seedlings (Neto *et al*., 1995) in Brazil. The genomic DNA was extracted from seedlings of 4 dwarf cashew clones (CP 06, CP09, CP76 and CP1001).The amplification products were generated by using six 10-mer arbitrary primers. Similarity coefficients revealed that there was a high genetic similarity between the seedlings CP-06 and CP-76 (0.778) which was confirmed with the fact that the clones CP-06 and CP-76 had common genetic origin. The seedling CP09 was observed to be the most genetically divergent in relation to the other seedlings.

Later, polymorphic profiles of RAPD markers were observed between cashew populations of diverse geographic locations viz.Brazil, Mozambique, Guinea Bissau, India and

Tanzania((Mneney *et al*., 2001)). Accessions from India, Mozambique and Tanzania showed closest relationship, while those from Brazil being the most distinct from other provenances. The relatively uniform RAPD profiles of Tanzanian cashew lines, however, indicated a high level of similarity among themselves which attributed to the fact that majority Tanzanian clones had their ancestry in Sri Lanka. The study indicated that the diversity within the germplasm of Tanzania was inadequate for breeding programmes and needed to widen genetic base. During these studies, it was felt that the dedicated (non random) PCR-based, yet more robust DNA markers like 'Sequence tagged sites' (STS) and 'Expressed sequence tag' (EST), developed from cloned genomic or cDNA libraries would be more useful practically in identifying a large number of mapped locations in the genome that corresponds to genes. Such a novel approach would precisely facilitate breeding for economically important characters and systematic exploitation of heterosis in cashew.

In India, application of molecular markers in cashew began only in the year 2000. Karihaloo and Archak (2000) used molecular markers in cashew as an aid to agro-biodiversity management. It was reported that cashew, despite being an introduced plant, exhibits high molecular diversity among its Indian cultivars. This was attributed mainly to the combined effect of its breeding system and continuous seed propagation, that together led to high level of heterozygosity and ensured the availability of multiple alleles. The observed variation in molecular markers, while reflecting the extent of genetic diversity in cashew grown in India, underscored the need to collect and screen the local germplasm for the important economic traits including pest and disease resistance and adaptability to diverse agro-climates.

Dhanaraj *et al*. (2002), in India used the RAPDs to estimate the diversity among 90 accessions from the National Cashew gene Bank (National Research Centre for Cashew , Puttur, Karnataka, India), which represented different cashew growing states and exotic collections. The accessions from different geographical regions were observed to be grouped together, probably due to continuous germplasm exchange between various research centers practiced for their evaluation in other parts of the country. The results indicated a moderate to high diversity in Indian cashew collections. Further, the core collection consisting of 54 out of 90 accessions including three *Anacardium* sp., the purple mutant plant, Mozambique introductions, CNSL free accession, 40 other accessions and 8 of 10 released varieties was reported to overcome the redundancy in germplasm bank.

At the same time, Rout *et al*. (2002) developed an efficient protocol for DNA extraction and purification from fresh leaves of different varieties of cashew for RAPD analysis at Orissa University of Agriculture and Technology, which could be useful for other woody species. In the same laboratory, similar studies by Samal *et al*. (2002) on genetic relatedness in 20 cashew germplasm collections determined by randomly amplified polymorphic DNA showed the highest similarity index of 87 per cent between Ullal-3 and H-1608. It was observed that Vengurla-2 and Vengurla-3 were not grouped into a single cluster, but Vengurla-4 had 82 per cent similarity with Vengurla-3, which in turn had a close similarity (85%) with VRI-3, a variety from altogether a different geographical location. The analysis of genetic relationships in cashew using morphological traits and RAPD banding data can be useful for plant improvement, descriptions of new varieties and also for assessment of variety purity in plant certification programmes (Samal *et al*., 2003 and Desai, 2008).

Molecular profiles of 35 cashew varieties of India (24 selections and 11 hybrids) were developed by using a combination of five RAPD and four ISSR primers pre selected for maximum discrimination and repeatability (Archak, *et al*., 2003a). Primer-wise and technique wise results revealed that five selected random primers generated 56 bands of

which 78.6 per cent were polymorphic which was observed to be was high enough to enable discrimination of all the varieties. Correspondingly, analysis of molecular variance (AMOVA) within a breeding centre was observed to be only 3.6 per cent and was attributed to the frequent exchange of genetic material among different breeding centers while developing the present day varieties as has been reported earlier by Dhanaraj *et al*. (2002). Further, a comparative assessment was carried out between varieties developed through selection and those obtained by hybridization indicating the need and scope for identification of more parental lines in enhancing the effectiveness of hybridization programmes in the country. These results also led to the development of the fingerprint pattern of the varieties in the form of bar code diagram. Subsequently, in a comparative studies comprising 50 random primers, 12 ISSR primers and 6 AFLP primer pairs (Archak *et al*., 2003b), AFLP exhibited maximum discrimination efficiency with a genotype index of 1. The utility of each molecular marker technique, expressed as marker index, was observed to be more than 10 times higher in AFLP than in RAPD and ISSR. Comparison of Similarity matrices, determined based on the data generated by molecular and morphometric analyses displayed no correspondence of AFLP with RAPD and ISSR. Correlation between ISSR and RAPD similarity matrices was observed to be low but significant. However, the similarity matrix based on morphometric markers exhibited no correlation with any of the molecular markers. AFLP, with its superior marker utility, was concluded to be the marker of choice for cashew genetic analysis.

Subsequently, Croxford *et al*. (2006) used an automated, high throughput system to isolate cashew microsatellites from a non enriched genomic library blotted on to membranes at high density for screening. Twenty one out of 65 sequences containing a microsatellite array, showed polymorphism among the closely related seed garden population of 49 cashew genotypes. Further, 12 markers were observed to be suitable for multiplex analysis, of which only 10 amplified in *A. microcarpum, A. pumilum and A. nanum.* These markers would provide a valuable resource for further hastening breeding programmes through map-based applications in cashew.

For the first time in cashew, two genetic maps comprising of 205 genetic markers (194 AFLP and 11 SSR markers) were developed by using F1 mapping populations of 85 individuals derived from a cross between CP 1001 (dwarf commercial clone) and CP 96 (a giant type) of Brazil (Cavalcanti and Wilkinson, 2007). The female map (CP 1001) contained 122 markers over 19 linkage groups, while the male map (CP 96) had 120 markers assembled over 23 linkage groups. Around 68 per cent genome coverage was observed in the female map in a total map distance of 1050.7 cM, whereas the corresponding values were 64 per cent and 944.7 cM in the male map. Homology between the two maps was established between 13 and 14 linkage groups of female and male maps respectively, using 46 bridging markers including 11 SSRs. These maps can be useful in identifying loci controlling economically important traits in cashew.

QTL mapping

This tool, once validated and applied practically, will be effective in bringing about the rapid crop improvement in cashew to address at higher pace the new challenges ahead.

Eighteen QTL associated with cashew apple quality were identified : three for oligomeric phenolics, five for total soluble solids, six for total acidity and four for vitamin C. These QTLs

are reported to be promising for marker-assisted selection since they have the greatest phenotypic effects and contribution to phenotypic variation (Santos, et al., 2011).

The methods of interval mapping and multiple QTL mapping were applied to evaluate 71 F1 genotypes. and subsequently, eleven QTLs (three for nut weight, four for male flowers and four for hermaphrodite Flowers) were detected . The QTL accounted for 3.79 to 12.98 % of the total phenotypic variance and had phenotypic effects of -31.81 to 34.25 %. The potential for marker-assisted selection of the QTL hf-2f and hf-3m appeared to be great and the phenotypic effects and percentage of phenotypic variation higher than of the others (Cavalcanti, et al, 2012).

Thimmappaiah, et al, (2009) studied diversity and genetic relationship in 100 cashew germplasm accessions by using RAPD and ISSR markers. Sixty bands were generated by using 10 selected RAPD primers, of which 51 bands were polymorphic (85%), and with 10 selected ISSR primers 67 amplified bands were observed with 58 polymorphic bands (86.6%). Though both kinds of markers discriminated the accessions effectively, analysis of combined data of markers (RAPD + ISSR) resulted in better distinction of accessions. By combining markers, a total of 127 bands were detected, of which 109 bands (85.8%) were polymorphic and produced on an average of 5.45 polymorphic bands per primer. Primers with high polymorphic information content and marker index were identified for discriminating accessions. High percentage of polymorphism (>85%) observed with different markers indicated high level of genetic variation existing among the accessions. Genetic relationship estimated using similarity co-efficient (Jaccard's) values between different pair of accessions varied from 0.43 to 0.94 in RAPD, 0.38 to 0.89 in ISSR and 0.43 to 0.87 with combined markers suggested a diversity (dissimilarity) ranging from 6 to 57%, 11 to 62% and 13 to 57% respectively and the diversity skewed around 50% indicated moderate diversity. The cluster analysis with UPGMA method separated the accessions broadly into 13 clusters and in that three into smaller clusters. Some correspondence between the molecular groupings and the morphological clusters were observed. Among the accessions, NRC-142 and NRC-12 were highly divergent and NRC-231 and NRC-232 were genetically similar.

The efficiency of the breeding and selection process can be assessed in many different ways including the ultimate success of the varieties released and the frequency with which new varieties are produced. A major cost and logistical issue in cashew breeding are the actual number of lines that need to be carried through the evaluation and selection phases of a program. Large breeding programs for crops like may carry hundreds of thousands of lines to produce a new variety after considerable long period of time and hence field trials can be expensive and evaluation of some traits, such as quality and yield stability can be technically and genetically complex requiring large batches of material. Molecular markers have proved to be a powerful tool in replacing bioassays and there are now many examples available to show the efficacy of such markers. The use of molecular markers to track loci and genome regions in crop plants is now applied in many breeding programs. The location of major loci is known for many disease resistance genes, tolerances to abiotic stresses and quality traits. Improvements in marker screening techniques have also been important in facilitating the tracking of genes. For markers to be effective they must be closely linked to the target locus and be able to detect polymorphisms in material likely to be used in a breeding program. The prime applications of markers in most breeding programs has been in backcross breeding where loci are tracked to eliminate specific genetic defects in elite germplasm, for the introgression of recessive traits and in the selection of lines with a genome make-up close to the recurrent parent. In progeny breeding, markers have proved valuable in building crucial parents and in enriching F1s from complex crosses. Markers have also improved the

strategies for gene deployment and enhanced the understanding of the genetic control of complex traits such as components of quality and broad adaptation (Peter Langridge, 2005)
Limitations in adoption of Marker assisted selection (MAS)

Although the identification of marker trait associations is now rapid for simply inherited traits and for many QTL, adoption rates within breeding programs has been slow. The key issues identified are:

- Lack of useful marker trait associations. Many breeders feel that the loci targeted for marker development have been selected by molecular biologists rather than the breeders.
- Poor polymorphism rates in "real" breeding material. Many marker development programs have been based around highly diverse germplasm, selected for ease of detecting polymorphism rather than value to breeding programs.
- Closeness of linkage. The closer the linkage the greater the reliability of the markers. Not surprisingly breeders would like diagnostic markers.
- Lack of resources for marker screening. Breeders are reluctant to redirect their current resources to marker screening and in many cases such redirection is not feasible. The most successful implementation programs have been funded separately from the core breeding programs. This applies to both public and private sector breeding operations.
- The long lead time for breeding means high risks to a breeding program if it modifies its breeding strategies. The real value of markers appears to lie in the development of new breeding strategies. The crosses, population size and screening methods using in traditional breeding and marker based breeding programs are not necessarily compatible.

Relevance of developments to other crops

Although the most detailed marker information is available for the major cereal crops, genetic linkage maps based around molecular markers are now available for most crop species. For some species, such as strong out breeders, long generation perennials and clonally propagated species, it may be slow and complex to develop useful marker trait association. This is the case for most tree crops. However, even for these crops, many maps are available. Usually, the maps have been constructed from populations segregating for traits of relevance to improvement programs although the germplasm may not be the most recent. For example, molecular mapping studies in cassava have identified loci and associated markers for productivity, plant architecture, and resistance to cassava mosaic disease. Therefore, in many respects the technology is sufficiently well developed to be applicable to most crop improvement programs and the examples of using MAS in cereal breeding should have direct relevance to other breeding programs. Although the breeding strategies may vary between crop species, there is sound reason to believe molecular markers could offer significant benefits to all breeding programs and could lead to increases in the speed of breeding and the sophistication of breeding programs.

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SOIL AND WATER CONSERVATION IN CASHEW

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Cashew is the prominent perennial horticultural crop, which has been contributing to the Indian economy significantly. Though India ranks first in area and production productivity is very low. One of the main constraints for low productivity is lack of *In-situ* moisture conservation measures and subsequent moisture stress during the summer. It is generally grown as a rainfed crop along steep slopes of hills or on neglected land unsuitable for any other crop. In India, cashew experiences severe moisture stress from January to May, adversely affects its flowering and fruit set.

One of the short-term strategies to achieve 10.00 lakh MT that can be absorbed by 1100 processing units established in the country is to increase per unit area productivity in the country. The best option available is to go for high density planting with suitable in-situ soil and water conservation measures instead of conventional cultivation method.

in-situ soil and water conservation

In situ retention of rain water in the field itself is the most efficient method to recharge and store moisture in the root zone for better plant growth. This can be achieved by suitable agronomic measures such as crop geometry, crop combinations, mulching etc., and also by promoting moisture retention by mechanical measures such as trenching, bunding, terracing, basin making or micro catchment, contour furrow etc., of which trenching being the most appropriate method.

Types of trenches

Continuous contour trench (CCT) : It is the trench which is made for the entire field length continuously along the contour at certain vertical interval.

Graded Trench (GT) : is the trench, which is made for entire field length continuously in different grades.

Staggered contour trench (SCT) : Has to be excavated for the length of 2 m, top width of 0.45 m, bottom width of 0.30 m and depth of 0.45 m in staggered manner of an aligned contour.

Semi elliptical trench (SET) : The trench with the length of 2 m, top width of 0.45 m, bottom width of 0.30 m and depth of 0.45 m prepared in respect to each plant in a semi elliptical manner on the upstream side of the plant is called Semi elliptical trench

Crescent shaped trench (CST) : The trench that will be taken up in crescent shape is called Crescent Shaped trench.

Bio Engineering measures: The trenches or terraces supported with live barriers are called bio engineering measures. Vegetative barriers such as *Vetivaria zizanoides, Stylosanthes scabra* and *Glyricidia maculata* can be planted as hedge crops on the bunds of trenches.

Individual tree terracing with crescent bund is the best soil conservation measure in slopy lands. Soil and water conservation techniques like modified crescent bund or staggered trenches with coconut husk burial helps in conserving moisture, reducing the annual runoff / soil loss and increasing the nut yield. Terracing taken up around each plant by cutting soil from the upper portion of the slope and filling the lower portion has been recommended. Catch pits around the plant not only helps in harvesting, retaining and making the water available to the plant for a prolonged period but also cuts the velocity of running water on the slopes thereby arresting soil erosion. Top soil eroded from the exposed portion of the hillocks also gets trapped in the catch pit. Thus, it plays triple role in preventing soil erosion, rain water harvesting and insitu moisture conservation.

Coconut husks are buried in trenches of 1 m width, 0.5 m depth and 3.5 m length/ plant opened across the slope between two rows of Cashew. Generally 3-4 layers of coconut husks are buried one above the other with convex side of the first layer of the husks touching the ground. After spreading a layer of soil on the first layer of the husks, second layer of husks is laid in the same fashion as that of the first layer. The last layer of the husks should be inverted so that convex side is facing the upper side. Thick layer of soil upto 10 cm thickness should be spread over this.

Modified crescent bund and coconut husk burial reduced the annual runoff (22.3 and 20.4% of the annual rainfall compared to 36.9% of the annual rainfall in control), soil loss (47 and 49% of control) and nutrient loss. Also it increased the mean soil moisture content, growth of plants, yield of cashew (6.45 and 6.60t/ha respectively compared to 4.88t/ha in control for the first 5 harvests) and net profit from cashew garden (40% more than control). In addition to this, the groundwater level in nearby wells and ponds increased. Hence, the barren land even in steep slopes with proper soil and water conservation measures can be effectively utilized for cashew cultivation. (DCR, Puttur).

Soil and water conservation measures In the case of slopy lands terracing should be taken up around each plant during the second and third year. Terraces should be of 1.8 to 2.0 m radius with a catch pit (1.5m x 45 cm x 30 cm) on the upper side of the terrace. The soil around the plant should be mulched with organic materials which will help to avoid direct exposure there by conserving soil moisture. Mulching The soil around the plant should be mulched with dried leaves or green leaves for conservation of moisture. (Cashew cultivation practices, KVK, CPCRI, Kasargod)

Studies were conducted at ICAR Research Complex for Goa, Old Goa on soil and water conservation measures for cashew by adopting different *In-situ* soil and water conservation measures. The continuous contour trenches with vegetative barriers was the best as compared to all other treatments for runoff, soil loss and nutrient loss reduction. Staggered contour trenches with *Stylosanthes seabra* and *Vetiveria zizanioides* was the alternative measure for reduction of runoff and soil loss for cashew land use. Additional income could be generated from the vegetative barriers, which can be used as either fodder or biomass for mulching during the initial period of cashew plantation by adapting the bio-engineering measures. Continuous contour trenches with vegetative barriers and staggered contour trenches with vegetative barriers were found economically viable and these technologies are recommended for adoption in the cashew plantations in hilly terrain.

Continuous contour trenches with *Stylosanthes scabra* and *Vetiveria zizanioides* and staggered contour trenches with *Stylosanthes scabra* and *Vetiveria zizanioides* reduced the runoff by 44.5 and 34.6 per cent, respectively under spacing of 4 m X 4 m cashew plantations. Similarly, continuous contour trenches with vegetative barrier of *Stylosanthes scabra* + *Gliricidia maculata,* staggered contour trenches with *Stylosanthes scabra* and *Gliricidia maculata* and crescent shape trenches with *Stylosanthes scabra* and *Gliricidia maculata* recorded runoff reduction of 46.3, 35 and 29.0 per cent, respectively in the field where cashew was planted at 6 m x 6m spacing.

Continuous contour trenches with *Stylosanthes scabra* and *Vetiveria zizanioides* and staggered contour trenches with *Stylosanthes seabra* and *Vetiveria zizanioides* reduced the soil loss by 11.3 and 8.1 t ha-1 yr1 in 4 m x 4 m cashew field. Similarly, continuous contour trenches with vegetative barrier of *Stylosanthes seabra* + *Glirieidia maeulata* significantly reduced average soil loss (6.5 t ha-1) followed by staggered contour trenches with *Stylosanthes seabra* and *Glirieidia maeulata* (5.6 t ha-1) and crescent shape trenches + *Stylosanthes seabra* and *Glirieidia maeulata* (5.7 t ha-1) in the plot where the cashew was planted at 6 m x 6 m spacing. Continuous contour trenches with vegetative barriers was the best when compared to all other treatments as far as nutrient loss reduction was concerned.

Highest soil and water conservation efficiency was observed in continuous contour trenches with *Stylosanthes seabra* and *Vetiveria zizanioides* (49.5 per cent) followed by staggered contour trenches with *Stylosanthes seabra* and *Vetiveria zizanioides* (37.1 per cent) under 4 m X 4 m cashew plantations. Similarly, maximum soil and water conservation efficiency was observed in continuous contour trenches with *Stylosanthes seabra* + *Glirieidia maeulata* (62.9 per cent) followed by staggered contour trenches with *Stylosanthes seabra* + *Gliricidia maeulata* (51.3 per cent) in the plot where cashew was planted at 6 m x 6 m spacing.

All the conservation measures significantly increased the growth and yield of cashew.Continuous contour trenches and staggered contour trenches with vegetative barriers recorded the maximum plant growth and yield. Total cashew nut yield of7.72, 14.21 and 18.1 q ha-1 were recorded in treatment comprising of continuous contour trenches with *Stylosanthes scabra* and *Vetiveria zizanioides* during fourth, fifth and sixth years, respectively under 4 m X 4 m cashew plantations. The total cashew nut yield of 6.80, 3.50 and 5.20 q ha-1 were recorded in treatment comprising of continuous contour trenches with *Stylosanthes scabra* + *Gliricidia maculata* during fourth, fifth and sixth years, respectively under 6 m X 6 m plantations. Maximum NPW of Rs. 4, 61,820 per ha was obtained under cashew cultivation with continuous contour trenches with *Stylosanthes seabra* and *Vetiveria zizanioides* followed by Rs. 4,08, 090 per ha under cashew cultivation with staggered contour trenches *Stylosanthes seabra* and *Vetiveria zizanioides.* Maximum NPW of Rs. 1, 64, 900 per ha was obtained under cashew cultivation with continuous contour trencFles with *Stylosanthes seabra* + *Glirieidia maeulata* followed by Rs. 1,27,190 per ha under cashew cultivation with staggered contour trenches *Stylosanthes seabra* + *Glirieidia maeulata.* Higher benefit cost ratio and Internal rate of return were obtained under the continuous contour trenches with *Stylosanthes seabra* and *Vetiveria zizanioides* (6.87 and 20 per cent, respectively) followed by staggered contour trenches with *Stylosanthes seabra* and *Vetiveria zizanioides* (6.82 and 18 per cent, respectively) under 4 x 4 m cashew plantation. Similarly, BCR and IRR were higher under the continuous contour trenches with *Stylosanthes seabra* and *Glyrieidia maeulata* (5.07 and 13 per cent, respectively) followed by the staggered contour trenches with *Stylosanthes seabra* and *Glirieidia maeulata* (4.64 and 12.5 per cent, respectively) under 6 m X 6 m cashew plantations.

Green Manuring:

Green manures can improve the soil by increasing organic matter, earthworms and beneficial micro organisms, increasing the soil's available nitrogen and moisture retention, stabilizing the soil to prevent erosion etc., Growing cover crops like *Mimosa invisa, Pueraria javanica, Calapagonium muconoid*es and *Centrosemja pubescens* enrich the soil with the plant nutrients and organic matter, prevents soil erosion and conserve moisture. Higher soil moisture content was observed in cashew orchard with green manure crops such as glyricidia (17.0 – 18.6% dry basis) and sesbania(15.5-18.3% dry basis)

Mulching

Mulching the tree basins will help in conservation of soil moisture and prevents soil erosion. The basin area of Cashew plants can be mulched either with green leaves, dry leaves or weeds soon after planting. Mulching with organic matter or residues inhibits weed growth and reduces surface evaporation during summer and also regulates the soil temperature. Black polythene mulch was helpful to conserve soil moisture. Using coconut coir pith as soil mulch in cashew plantations resulted in 14.15% more water retention and suppression of weeds to an extent of 73.52.

PROPAGATION AND NURSERY MANAGEMENT IN CASHEW

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1. INTRODUCTION

Cashew is a cross pollinated and therefore, the seedling progenies are heterogenous due to segregation. Whereas the clonal progenies are true-to-true of the mother plant and give relatively more uniform yield and come to fruiting earlier than the seedling progenies. Different methods of vegetative propagation, namely layering, grafting and budding have been tried in cashew both at National Research Centre for Cashew (NRCC) and different Cashew Research Stations in the country. Studies conducted at NRC Cashew, Puttur and All India Coordinated Research Project (AICRP) on Cashew Centres, have indicated the superiority of “Softwood grafting” technique over other methods and hence, this technique has been standardized and recommended for taking up of commercial multiplication of cashew varieties.

In case of softwood grafting about two month old root stocks of cashew and 3-5 month old scions are utilized for grafting by adopting “cleft or wedge” method of grafting. Since softwood portion of the rootstock is utilized for making cleft and the scion is mended into wedge shape, this method is know as softwood grafting technique.

Softwood grafts can be prepared almost throughout the year with a mean graft success of 65-70 per cent saleable grafts. However, the best season for grafting would be June to November under Dakshina Kannada weather conditions. The cost of production is comparatively cheaper and field establishment of softwood grafts is very high.

2. TERMINOLOGIES

Grafting	:	Grafting is joining of two plant parts.
Root stock	:	Rootstock is the lower portion of the graft which has the root system of the grafted plant
Scion	:	Dormant buds is a short piece of detached shoot (lateral shoot) containing several dormant buds, which when united with root stock results in the upper portion (canopy) of the grafted plant.
Wood / sap wood (xylem)	:	Through wood the sap is drawn up from the roots and translocated to leaves.

Bark (phloem)	:	The carbohydrates synthesized in the leaves will be distributed / transported to roots via phloem. Protecting the phloem there is an outer skin called the bark.
Cambium layer	:	It is one celled thick strip around the outer side of sap wood (xylem) and inner side of bark (phloem). It manufactures new growth by rapid multiplication of cells. Cambium layer is important in healing of graft joint and establishing the connection between root stock and scion.

3. SCIONS FOR GRAFTING

a) Production of scion sticks

Scion bank for the recommended cashew varieties should be established by adopting a closer spacing of 4m x 4m and it should be maintained properly for getting continuous supply of scion sticks for commercial multiplication.

b) Selection of scion sticks and precuring

- Non flowered lateral shoots of current season's growth (3-5 month old) are to be selected.
- The selected shoots should be 10-12 cm long, straight, uniform round with brown coloration and of pencil thickness.
- The leaves are to be removed using a secateur (precuring or defoliation) 10 days in advance of grafting.

c) Collection of scion sticks

- The precured scion sticks should be collected from the mother trees before the terminal buds sprout.
- The scion sticks should be separated from the mother tree preferably during morning hours.
- The detached scion sticks may be dipped in cold water and then placed in a polythene bag of 100 gauge thickness and brought to the grafting shed and utilized for grafting.

4. ROOT STOCK SEEDLINGS FOR GRAFTING

a) Selection of cashew seeds for sowing

- Cashew seeds should be collected during the peak period of harvest (February-April).
- Collected from a single variety block.
- The seeds should be sun dried for 2-3 days.
- Medium sized (6-7g) and dense seeds should be selected.
- The seeds gradually loose viability after 8-10 months of storage.

b) Preparation of potting mixture and filling of polythene bags

- The potting mixture should be prepared in the proportion of 1:1:1 (red soil; coarse river sand: compost) in heavy rainfall areas and 1:1 (red soil: Compost) in low rainfall areas. Rock Phosphate @ 5g/kg of potting mixture may also be added for getting good root growth of seedlings.
- Polythene bags of 25 cm x 15 cm size and 300 gauge thickness should be used for filling potting mixture.
- In heavy rainfall areas, 30-40 drainage holes of 0.5 cm diameter may be punched uniformly on the polythene bags. In low rainfall areas, the number of drainage holes can be few.
- Potting mixture should be filled upto the brim level.
- The filled bags should be arranged in beds of 1000 number each (100x10).

c) Sowing of seeds

- The cashew seeds should be soaked in water for 12-24 hours before sowing. Seeds need not be presoaked during rainy season.
- The seeds should be dibbled in the centre of the polythene bags, stalk-end upwards and covered with little soil.
- The depth of sowing should be not more than 2.5 cm.
- Immediately after sowing and every day after sowing the seed beds should be watered depending upon the weather conditions.

- During rainy days, if water stagnation is observed, excess water should be removed by pressing the sides of bags.
- During dry months seedbeds may be mulched with paddy straw till the germination takes place. Agro shade nets may also be used for this purpose.
- The seeds will germinate 10-15 days after sowing depending on the weather condition.
- Seeds should be sown at regular intervals (weekly/fortnightly) to get continuous supply of desired root stock seedlings for grafting depending upon the number of grafters available.

d) Maintenance of seedlings in the nursery

- The seedlings should be watered daily depending upon the weather conditions.
- During monsoon season, if water stagnation is observed, the polythene bags may be pressed from sides, so that the excess water drains out of the bags. This reduces the incidence of collar rot/damping off of seedlings.
- During rainy season, the seedlings should be sprayed with Bordeaux mixture (1%) at 10 days interval to control collar rot/damping off of seedlings.
- The seedlings may be sprayed with systemic insecticides such as monocrotophos (1.5 ml/litre) to control tea mosquito and other pests at regular intervals.
- The side shoots arising from the axils of leaves should be removed frequently in order to get vigorous seedlings with single main stem.

5. SOFTWOOD GRAFTING TECHNIQUE

a) Preparing the root stock seedling for grafting

- The grafting operation should be carried out under the shade either in a grafting shed or makeshift shelters.
- About two month old seedlings (of 25-30 cm height) are selected as root stocks. The girth of the seedling should be about 1cm at the place of grafting.
- On selected root stock seedling, two pairs of bottom leaves are retained and the other leaves are removed with a sharp grafting knife.

- Then the terminal shoot is decapitated at a height of 15 cm (where soft wood portion is available for grafting).
- A cleft of 6-7 cm deep is made on the decapitated stem.
- From the inner sides of the cleft a little portion of wood is removed at the tip.

b) Preparing the scion stick for grafting

- If the scion stick is longer, then it should be reduced to a length of 10-12 cm by cutting off the excess portion at the bottom. Very short scion sticks should be discarded.
- The scion stick should be carefully mended into a wedge shape of 6-7 cm long. However, care must be taken to retain the bark on either side of the wedge. The cut surface should be smooth and it should not be soiled at the time of preparing the wedge.

c) Grafting operation

- The wedge of the scion is inserted carefully into the cleft of the root stock. If the scion is thicker in girth, then care must be taken to match the cambial layers of both root stock and scion at least on one side with the help of finger.
- Then the graft joint is secured firmly with a polythene strip (2.0 cm wide, 30 cm long and 100 gauge thickness).
- Then a long and narrow white polythene cap (20 cm x 4 cm size and 200 gauge thickness) is inserted on the grafted plant.
- After 3 weeks, the polythene caps are removed gently and the grafts are shifted to open area in the nursery.
- At the time of removing the caps, about 70-80 per cent of the grafts show sprouting.

6. SEASON OF GRAFTING

Monsoon season (June-November) is the best season for grafting under the weather conditions of Dakshina Kannada (West Coast) and a graft success of over 80 per cent can be obtained due to favorable weather conditions and availability of proper mature scion sticks. During other season the graft success varies from 50-60 per cent due to non availability of proper mature scion sticks in sufficient numbers and less favorable weather conditions. However, soft wood grafts can be produced

almost throughout the year with a mean graft success of 65-70 per cent. Grafting may be suspended during Dec-Jan as there will be poor graft success in winter.

7. MANAGEMENT OF GRAFTS IN THE NUSERY

Generally the cashew grafts produced during monsoon season (June- November) are to be maintained in the nursery till the next planting season (July-August). Therefore, the following points should be considered:

- In the nursery, the grafts should be arranged in beds after spreading black polythene sheet on the ground to prevent the grafts from striking their roots into the ground. Otherwise, frequent shifting of grafts from one place to another place is required which involves labour.
- The grafts should be watered daily depending upon the weather conditions.
- During heavy rainy season, if water stagnation is observed in the bags, then the excess water may be removed by pressing the sides of the bags.
- During summer, the grafts should be provided with partial shade by erecting pandal and covering with agro shade nets (35-50% shading). As soon as the monsoon starts, the shade should be removed. Complete shading should be avoided as it results in lanky and weak growth of grafts. Laminated shade nets (35% shading) may also be used.
- During rainy season, the grafts may be sprayed with bordeaux mixture (1%) at 10-15 days interval. Spraying should be done when the weather is clear.
- The grafts may be sprayed with systemic insecticides such as monocrotophos (1.5 ml/litre) to control insect pests such as tea mosquito, leaf minor, leaf eating caterpillars etc.
- The side shoots arising from root stock portion of the grafts should be removed frequently.
- During November/December, the flower panicles coming from the grafts in the nursery should be removed frequently.
- After 4-5 months of grafting, the polythene strip should be removed from the graft joint. Otherwise, there will be girdling at the graft joint. However, the polythene strip should be removed before selling the grafts.
- After three-four months of grafting, the bottom leaves on the root stock portion of the graft should be removed.

8. COST OF GRAFT PRODUCTION

On an average 65-70 per cent saleable grafts can be realised on commercial scale. The estimated cost of production per graft varies from Rs.13/- to Rs.14/- depending upon the cost of inputs (cost of materials and labour).

9. GRAFT PRODUCTION UNDER LOW COST POLYHOUSES

By employing low cost polyhouses, softwood grafts can be produced almost throughout the year. Low cost polyhouses prepared from casuarina poles/areaca reapers etc. and covered with Silpaulin brand plastic film (natural colour) of convenient dimensions (preferably 11 m long and 6 m wide sheets with eyelets at regular distance) may be utilized for grafts production. The height of polyhouse in the centre should be 2.0-2.25 m and the height in the sides should be 1.0 m. Depending upon the cost of material (Silpaulin sheet, poles, GI wire etc.) and labour, each polyhouse may cost about Rs. 3000/-. Each polyhouse may accommodate about 4000 filled bags of 25 cm x 15 cm size and about 6000 filled bags of 20 cm x 12.5 cm size. Raising of rootstock seedlings, grafting of rootstocks and further maintenance of grafts can be done inside the polyhouses. This will save the labour required for supplying root stock seedlings from nursery area to grafting shed and shifting of grafts from grafting shed to nursery area. The polyhouses will also give protection to the seedlings and grafts during heavy rainy season and reduce the mortality due to fungal diseases. The plants may be watered using hose pipe fitted with a fine rose. Misting units may also be fitted at suitable points and switched on for about 5-10 min at an interval of 2 hours from 10 AM to 6 PM during summer months. This reduces the temperature build up inside the polyhouses. During summer months the Silpaulin sheet has to be removed and shade net (35-50% shade) is to be used.

10. GENERATION OF CASHEW PLANTING MATERIAL

Government of India, realizing the viability of the softwood grafting technology, has come forward during the VIII Five year plan to establish Regional Nurseries in different cashew growing States. Today we have 83 units of Regional Nurseries in the country supported by Directorate of Cashewnut and Cocoa Development (DCCD), Ministry of Agriculture, Cochin. These nurseries have the production potential of over 80 lakh grafts annually. From 1992-93 to 2000-2001, these Regional Nurseries could produce and supply about 3.77 crores of quality planting material to the farmers and development agencies, covering an area of about 1.70 lakh ha. With the area expansion taking place with high yielding clones, we will be able to achieve the requirement of one million tons of rawnuts for processing in India.

11. IMPORTANT DO'S AND DONT'S

- The length of scion should be 10-12 cm with pencil thickness.
- Very short scions and very thin scions should not be collected for grafting.
- For raising uniform and vigorous root stocks, always collect seeds from a single variety block and use graded seeds (mediums size and dense seeds).
- Application of good quality compost / cattle manure is a must to raise healthy and vigorous seedlings with proper stem girth.
- Pre-soaking of seeds for 12-24 hours helps in quicker and good germination.
- Seeds should be sown at weekly/fortnightly intervals to get continuous supply of desired root stock seedlings.
- To control the collar rot incidence in the germinating seeds and young seedlings of less than one month old, spraying of Bordeaux mixture (1%) during rainy season at 10-15 days interval is to be done.
- At the time of grafting two pairs of bottom leaves should be retained on the root stock and a cleft of 6-7 cm deep is to be made at a height of 15-20 cm.
- The scion should be mended into a wedge shape of 6-7 cm length.
- The cut surfaces of the wedge should be smooth and they should not be soiled or disturbed by touching with fingers.
- At the time of grafting, the cambial layers of both rootstock and scion should be aligned atleast on one side with the help of finger.
- The graft joint should be secured firmly with a polythene strip of 2.0 cm width and 30 cm length and 100 gauge thickness. Thicker gauge strips should not be used, as this results in loose tying and failure of graft joint to heal. Moisture may also enter through the graft joint resulting in rotting at graft joint.
- The grafted plants should not be allowed to strike their roots into the ground. In order to overcome this problem, arrange the grafts on black polythene sheet (300 gauge thickness) in the nursery.
- During summer months the grafts should be provided with partial shade (< 50% shade) using agro shade nets / coconut fronds. Complete shading should be avoided. Shade nets should be removed when once the monsoon sets in.
- The suckers arising from rootstock portion of the graft, and flower panicles arising from scion should be removed.
- The polythene strip from the graft joint should be removed after five months of grafting, before girdling takes place at the graft joint.

- Before sale, the grafts in the nursery are to be hardened by withholding water or watering on alternate days.

- Low cost polyhouses may also be used for graft production. Raising of root stock seedlings, grafting and maintenance of grafts etc. can be done inside the polyhouses. This will save labour required for shifting of plants. The polyhouses will also give protection from rains and incidence of collar rot will be minimum.

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ESTABLISHMENT AND MANAGMEENT OF CASHEW ORCHARDS

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A) Selection of site and soil management

Great harm has been done to cashew cultivation by notions like "cashew is very modest in its soil requirements and can adopt itself to varying soil conditions without impairing productivity". As a result, the worst soils have always been selected for cashew, where no other crop could give an economic return. As a matter of fact, cashew performs much better on good than on poor soils, but its yield potential has never been tried out on good soils, using the best available plant varieties, fertilizers and pesticides such as those used for other crops to which cashew is compared.

To get fairly economical return from cashew it is always preferable to select proper land suitable for cultivation. It is well known fact that cashew is fairly deep-rooted crop with its active roots concentrated in the first 1 m depth of the soil and 2 m radius around the trunk of the tree. So, soil should be minimum 1.5m deep without any hard laterite substratum or granite or any other hard pan which obstructs root growth.

The best soils for cashew are deep, friable, well drained sandy loam soils without a hard pan as explained above. Presence of water table at 5 to 20 m deep is quite congenial for this crop. Deep red laterite soils are also very much suitable for this crop.

The land should be exposed to sunlight all round the day. The crop comes up well even in the very slopy land also provided proper soil conservation measures are followed.

Soil management

In general the crop received minimum attention by the farmers. The crop is mostly raised in poor soil which require proper management to enrich fertility level.

In the case of slopy land, particularly in Kerala and Dakshina Kannada district of Karnataka the soil is very poor. Owing to frequent exposure to weather conditions, particularly heavy rainfall the top soil is almost completely eroded and the subsoil with poor nutrient reserve is exposed in the elevated and slopy lands. If the crop is planted in such soil the yield/tree is generally poor provided, proper soil management is not followed. The following soil conservation measures can be taken up to improve the soil fertility subsequently.

(i) Filling of natural gullies

The natural gullies formed during the rainy seasons have to be filled up at lower level at regular distances with, boulders and soil and planting of grasses which bind the soil very quickly and reduces erosion of fertile soil. In due course of time the gullies are filled up with soil settled at depressions. If the gully checks, as discussed above, are constructed at regular distances, erosion of fertile soil can be arrested.

(ii) Contour bunding

Depending upon the slope of the land the contour bunds of 60 cm height and 2m width at regular distances can be formed to check soil erosion during rainy season and to conserve moisture during pre-monsoon and post monsoon showers. The distance from one bund to another bund will depend upon the degree of slope. If the slope is more than 25%, the spacing from one contour bund to another is around 8m. The crop can be planted at 8m distance along the contour line to further check soil erosion.

(iii) Terracing

By second or third year of planting terracing of 1.8m radius around the trunk of the plant has to be done by cutting across the slope and spreading below. So that the water received through rain drop, runoff or seepage is absorbed directly to the soil within 1.8m radius around the trunk of the plant to make it available to the root zone. This minimises soil erosion, nutrient loss through runoff etc. A catch pit across the slope at the periphery end of terrace is to be provided for withholding water during pre-monsoon and post-monsoon showers in the slopy area. A small channel sidewise connecting the catchpit is to be provided to drain out excess water during rainy season. If the terracing is done after 3 years the roots of the crop get damaged while levelling. As a result the crop suffers. In the levelled land the base of the plant is raised by applying soil all around wherever there is likelihood of water stagnation during rainy season.

(iv) Growing cover crop

The cover crop seeds like Peuraria phasioloides, Calapagonia muconoides, Mimosa invisa @ 7.5 kg seeds/ha on the contour bunds and also in the interspaces of the main crop at 3 to 4 m distance are to be sown by loosening top soil enriched with farm yard manure with the onset of monsoon. The cuttings of Mucuna bracteata can also be planted at 3 to 4 m distance.

Depending upon the fertility and moisture holding capacity and rainfall the cover crops spread and cover the entire ground within two to three seasons. Excess growth of the cover crop can be cut and the cut materials can be spread at the base of the plant as mulch. The cover crop not only conserves moisture, by checking evaporation and reducing soil temperature but also

improves the soil fertility level by adding organic matter to the soil in the process of recycling. It also fixes atmospheric nitrogen and make available this nutrient to the crop steadily. The cover crop even checks growth of noxious weeds like Eupatorium odoratum and Pennisetum polystechyon by its smothering effect and competition. For the early establishment of cover crop in the beginning, the uprooting of noxious weeds and other jungle growth should be done.

B) Recommended Agro techniques

Till recently cashew plantation received very little attention. An analysis of production figures in India shows that the increase in production has not been proportionate to the increase in area under cashew. Cashew plantations are raised in marginal land where no other crop can give an economic return.

The reason for the low production can be attributed to a large proportion of the plantations consisting of seed sown seedlings under poor management, conceivably the production potential of these plantations is very low.

Cashew can grow on poor or stony soil mainly due to its extensive root development and thereby, increasing greatly the available volume of soil from which it can draw nutrients and water. Reasonable yields are obtained as long as there is sufficient soil between the stones to allow the roots to penetrate and specially if deeper, more favourable soil layers can be reached. Crops with less extensive root system might perish on such soils. Scientific management of cashew orchards has become imperative to increase the production of cashewnuts to the maximum extent possible within the shortest time.

Land preparation, manuring, irrigation, drainage, cultural operations, weeding, mulching, cover cropping, pruning, high density planting and intercropping are some of the important aspects to be considered for improving the production potentials of the cashew orchards.

Land preparation and sowing of cover crop seeds

With the onset of monsoon the land must be cleared of all bushy growth and noxious weeds. Soon after the receipt of pre-monsoon showers the stumps of bushy growth should be uprooted and the noxious weeds are also uprooted when the soil is soft with moisture. Soon after that with the onset of actual monsoon season the cover crop seeds like Calapagonia muconoides or Mimosa invisa or Peuraria phasioloides should be sown @ 7.5 kg seeds per hectare on the contour bunds if the land is slopy and also in the interspaces of the rows of main crop proposed to be planted. The seeds are sown by loosening top soil enriched with farm yard manure.

The pits of 60 cm x 60 cm x 60 cm (lbd) are opened at 7 to 8 metre distance either following square or triangular method. Hedge row system of planting can also be adopted (the distance between rows 10m and between plants within row 5m). The size of pits is upto 1m x 1m x 1m in soils with hard pan or hard laterite substratum. Opening the pits along the contour line is preferred in slopy area. The pits have to be

filled with mixture of top soil, compost (5 kg) or poultry manure (2 kg) and rock phosphate (200 g). A small channel above the pit is opened to divert water to the sides during rainy season in slopy lands. The run off water should not accumulate in the pit which causes water stagnation during rainy season.

Planting

Planting is done preferably during the first week of June with the onset of monsoon. The soil in the centre of the filled up pit is scooped out. The polythene bag (containing graft) covering the root and soil is removed carefully and the graft with ball of earth intact is separated. The graft is placed gently in the centre of the pit where soil was scooped out and covered with soil and pressed gently. The graft is planted in such a away that the graft union is above the soil level. Sprouts, if any, below the graft union on the root stock are removed with the help off sharp knife. Plastic ribbon covering the union is removed if not done already. Later mulch is provided at the base around the plant to prevent soil disturbance during rainy season and also to suppress weed growth and conserve moisture in the soil. The plant is then staked by erecting. 1 m stick and loosely tied with coir or plastic string.

After care

Sprouts emerging from the rootstock are removed at regular intervals as and when seen. The graft should be allowed to grow by maintaining single stem upto 0.75 to 1 m height by removing sprouts or side shoots not only below the graft union (stock portion) but also above it (only side shoots on the scion portion are removed allowing apical bud to grow). Staking the plant in the second year also by replacing the spoiled and weak support fixed in the first year with strong stick is necessary. When the plant grows to a height of 0.75 to 1 m with single stem, the graft is likely to lodge due to wind blow and hence it has to be staked in the second year also with a strong support.

The flower panicles emerging later in the season need to be removed during the first two years of growth of the graft to boost up proper vegetative growth and thereby achieving proper height and good canopy. The plants are allowed to flower and fruit from third year onwards.

Weak and criss cross branches are removed leaving 4 to 5 strong ones. The canopy of the plant should be round parallel to the ground and vertically semicircular Jettisoning branches on one side only when noticed should be pruned for providing round and compact shape to the plant (open umbrella shape).

Studies on root distribution of a 10 year old cashew trees revealed that more than 90 per cent of the cashew roots are within 2 m radius and maximum depth upto which roots extended was 9.5 m. But more than 90 per cent of the cashew roots are found within 1m depth. The cultural operations should then be restricted to 1 m depth and 2m radius around the trunk of the tree, so that whatever nutrients applied can go to the root zone. Cashew is commonly grown on slopy land in west and east coasts. Soil erosion and leaching of plant nutrients are generally expected in such situations. To avoid soil erosion terracing and catch pit opening are essential.

Terracing and opening catch pit

In the second and third year, terrace of 1.8 m radius around the trunk of the plant is to be formed in slopy areas by cutting the soil across the slope and spreading below. A catch pit across the slope at the periphery end of terrace is to be provided for withholding water during pre-monsoon and post monsoon shower in slopy areas. A small channel connecting the catch pit-sidewise is to be provided to drain out excess water during rainy season.

Manuring

Research findings do indicate that cashew require regular fertilizer application to ensure early and higher yield in new plantation and regular high yields from mature trees. It was reported that a 30 year old cashew tree removes 2.80 kg N, 0.75 kg P_2O_5 and 0.75 kg K_2O per year.

Preliminary trials on nutrient requirements indicated that annual application of 750 g N, 150 g P_2O_5 and 150 g K_2O per tree per year is optimum dose for cashew. It was advised to apply the fertilizer in single dose in post-monsoon season when there is optimum moisture in the soil.

During the first year of planting 110 g urea and 200 g rock phosphate are to be applied. For application of fertilizers, a circular trench of 10 cm depth at a distance of 0.5m from the centre of the trunk is to be opened and the trench should be closed immediately after the application of fertilizers.

In the second year, ⅔ of recommended dose of fertilizer is applied in circular trench of 10 cm depth at a radius of 0.75 m away from the plant and covered with soil immediately.

From the third year onwards, full dose of fertilizers is applied at the radius of 1.5m away from the plant to the circular trench of 25 cm width and 15 cm depth and covered with soil.

Irrigation and drainage

Cashew being a hardy crop with extensive root system can absorb soil moisture from deeper layers and in general the crop is not irrigated. However, in initial stage cashew may require irrigation in summer especially in sandy soils. The experimental results showed that with irrigation cashew yield can be increased to 1.5 to 2 times. For a grown up tree i.e., four years onwards irrigating @ 200 litres per tree once in fifteen days from January to March is beneficial. Drip irrigation right from planting upto seven years @ 60-80 litres per tree once in four days was also found equally beneficial. Care must be taken to see that plants are irrigated only after flowering. Depending upon varietal character irrigation should be started one or two weeks after flowering. Hence, wherever irrigation facilities are available, the crop can be irrigated to get more yield and profit. Cashew cannot withstand water stagnation, flooding or impeded drainage. Adequate drainage should be provided wherever there is possibility of water stagnation.

Weeding

Weeds may compete for nutrients, moisture and also for light with cashew plants. Keeping the cashew orchards free of weeds is one of the important aspects of management. The first round of weeding may be done before heavy rains and fertilizer application (June) and the second weeding may be taken up during fertilizer application which falls normally in the month of August-September. Weeds have to be slashed or uprooted before seed setting in weeds so that multiplication of weeds is reduced considerably. In the initial two to three years of the establishment of graft in the main field, weeds are to be removed 2 m around the plant. The weeds prevailing in the remaining interspaces are to be slashed twice annually.

Mulching

Mulching the cashew plantations with organic matter prevents weed growth, reduce surface evaporation, during summer regulates the soil temperature, improves the soil fertility and also prevents soil erosion. Therefore, green matters obtained during weeding may be utilised for mulching the plantations at the base of the respective trees.

Pruning

Cashew is sun loving tropical tree and does not tolerate excess shade. Providing uniform sunlight to each and every part of the canopy therefore assumes major importance to increase the production. Though regular pruning is not advisable for cashew owing to its exuding gum resins from the cut ends, whenever the trees and branches are over crowded the excess branches may be removed for facilitating uniform and maximum interception of sunlight by the crop canopy.

ORGANIC FARMING IN CASHEW

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Introduction

Cashew is grown over an area of 10.07 lakh ha with a production of 7.36 lakh tons in India. The cashew is generally grown on least fertile soil. Added to this cashew is a neglected crop. Result is non-exploitation of full yield potential. Fertilizer management in cashew is very much crucial. Because, cashew being totally neglected crop does not receive manure at all. If fertilizers are applied significant increase in yield is realized there by exploiting maximum production potential of the crop. Considering average annual removal of major plant nutrients at the present level of production by six and above years old cashew trees and total productive area under cultivation in India the total nutrient removal from soil is up to the tune of 185 thousand tons of N, 40.24 thousand tons of P_2o_5 and 120 thousand tons of K_2o annually. Actual estimated addition of the nutrients through fertilizer application is meager for the reason that only 20% of the total area (1, 43,250 ha) under cultivation receives fertilizers. If we take this into account 11.17 thousand tons of N, 2.99 thousand tons of P_2o_5 and 2.7 thousand tons of K_2o are applied through fertilizers. This much quantity of fertilizers is too low compared to any other horticultural crop

Though cashew tree sheds 20-40kg leaves and apple annually 50% of this is used for composting and application to other important crops like Areca nut, coconut and rice in west coast and East coast region where cashew is generally grown in addition to the above crops. There is a local practice of collecting cashew leaf litter at the time of harvest of the crop which coincides with summer season and apply the same to cattle shed where it undergoes half decomposition due to presence of cow dung and cow urine and trampling of the biomass. Such half decomposed biomass instead of applying to cashew garden goes to other important crops like areca nut, coconut and rice. Occasionally cashew leaf litter is also collected for fuel purpose. These practices lead to general depletion of nutrients in cashew garden every year there by reduction in productivity. If the above mentioned huge quantity of biomass is properly utilized for application to cashew garden considerable quantity of nutrients can be retained for replenishment of nutrients. Appreciable quantity of nutrients present in the crop residue often not recycled in to the system in a systematic manner. The potential nutrients in recycling of biomass generated in cashew has been quantified as 33.8 kg N, 17.6 kg P_2o_5 and 20.6 kg K_2o/ha/year and considerable quantity of other essential elements including micronutrients (Anonymous, 2003). These organic forms of nutrients improve soil health through their effect on soil physico-chemical properties and microbial actions. All the same, use of chemical fertilizers is the easiest way of boosting crop yield. However, its increasing cost and removal of subsidies to the farmers and environmental problems the farmers are inclined to prefer organic manure to inorganic manures. The farmers of the developed and developing countries are beginning to realize the harmful effects caused by excessive use of chemical fertilizers and pesticides on the food crops produced. Those who are already conscious of the problem are now focusing attention on cost-effective and nature-friendly technologies, partly owing to the reason that present agriculture based on chemical fertilizers is becoming less and less competitive and partly also in response to the changing consumer preferences for farm produce free from chemical contaminants. Such farmers are evincing interest in leaning towards organic agriculture as

an alternative farming system. Though integrated nutrient management involving application of both organic and inorganic manuring is suggested to be the best, it is not catching up to the expected level. Technological interventions for organic production of cashew are discussed in this paper.

Varieties recommended for organic farming

Only mid and late season varieties are best suited for organic farming. The reason being that in early season varieties the crop flushes early and flowers early, which attract maximum infestation of tea mosquito. Because it is during this period (November-January) the climate is cool and dewfall during early morning followed by cloudy day results in maximum spoilage of the flowers due to highest infestation by the Tea mosquito Bug. Mid and late season (February-April) varieties escape this. Due to increased temperature during flowering and fruiting in mid and late varieties the tea mosquito population comes down thereby the crop damage due to TMB is minimum or nil. As such, control of TMB does not arise under such situations. However, under extreme changed weather conditions favorable to sudden out break of TMB controlling this pest even with chemical means is also difficult. Some of the most promising mid and late flowering varieties released are given below.

Mid season flowering varieties.

Bhaskara, Dhana (H1608), Dharashree, Amrutha (H1597), Priyanka (H1591) BPP-8, V-4, V-7.

Late season flowering varieties.

Ullal-1, Chinthamani-1 and Madakkatara-2

Production of vegetatively propagated cashew grafts organically.

The pot mixture used for raising seedlings meant for grafting should contain organic manure (cow dung), rock phosphate and biofertilizers. The potting mixture should have one1/3rd soil, 1/3rd cow dung and the remaining 1/3rd sand and 5 g each of Azospirillum, pseudomonas and Aspergillus biofertilizers and 5 g of rock phosphate. Bags filled with potting mixture is kept for raising seedlingsorganic

Planting pit and spacing

Planting grafts in bigger pit of size one cubic meter size after filling 2/3rd depth with topsoil, farmyard manure of 5kg/pit or 2kg poultry manure or 1 kg castor cake/pit is recommended. Planting of cashew grafts should be at 2/3rd depth and after planting it should be properly mulched. Normal soil and water conservation measures like terracing with crescent bund (Rejani and Yadukumar, 2007) should be taken within three years after planting. Spacing maintained can be 8M x 8M, 10M x 5M under normal density planting system and 5M X 5M, 6M X 4M under high density planting system.

Organically recyclable biomass waste (crop residue) available in cashew garden as potential nutrient source.

In general every year considerable quantity of leaf litter and cashew apple are available at the base of the crop if the same is not taken away from the location. The cashew leaf litter, apple waste and weed biomass collected at the base of the plant is to the tune of 40 kg/tree/year. When it is decomposed 65 % recovery can be expected. This amounts to 26 kg of biomass. This half decomposed biomass contains around 0.65 % N, 0.41 % P, 0.45 % K, 0.22 % Ca, 0.19 % Mg, and 369ppm Fe, 14.6ppm Cu, 16.5ppm Zn and 283 ppm Mn (Yadukumar and Nandan, 2005). The total macronutrients added to the soil when above biomass is incorporated will be approximately 169g N, 107g of P_2O_5 and 117g K_2O/tree. Soil mineralisation also takes place in the system thereby releasing the nutrients in available form. In addition to the utilization of native soil nutrients cashew requires additional quantities of nutrients for economical yields.

Results of the organic manuring trials

In an experiment conducted at NRCC, Puttur (2000-2003) it indicated that application of 20 kg poultry manure alone with soil conservation technique (With crescent bund) increased the yield by 80 per cent compared to control plot (Table.3). Subsequently to understand the performance of the crop for different combinations of organic and inorganic manures a trial was laid out in 2002 and continued up to 2003 on six and seven years old cashew trees (NRCC Selection 2 variety). The results indicated that application of biofertilizers-Azospirilum with the compost of organically recyclable biomass (ORB) available in cashew garden to meet 100% N requirement gave the highest yield of 1.053 t/hectare on the seventh year where as in the previous year it gave minimum yield. This indicated that in the long run this treatment is good. Next highest yield obtained from plot receiving 50-75 % N through inorganic fertilizer and remaining 25-50% N through compost of organically recyclable biomass (1.02 and 1.03t/ha, Table 4). Compost of ORB available in cashew garden was prepared by adding 20% of weight of total biomass with cow dung slurry. The compost so prepared contained 1.6% N, 0.54% P and 0.4% K and considerable amount of other of micronutrients. The procedure to convert cashew leaf litter and waste apple available in cashew garden into suitable compost material in a large scale is standardized at NRCC, Puttur

Preparation of Vermi compost

Attempt was also made to prepare Vermi-compost from the recyclable biomass available in cashew garden especially cashew leaf liter and apples. Cashew leaf litter and apples are allowed to decompose for 20 days after mixing with 15 % cow dung slurry. Then the material is fed to earthworms that were developed previously in plastic bucket by feeding cow dung material. Vermi compost chambers can be prepared as per the following details. Simple structure of chamber with 1.5 M height, 5 M long with 1.5 M width measurement is erected. At the bottom the chamber there should be a cement channel to fill water to prevent entry of ants. The chamber should be shaded during summer and protected from rain during rainy season by covering with shaded nets and silpauline sheet or any local thatching materials like coconut or areca nut leaves spread over the roof constructed specially for the purpose. For drainage of Vermi wash a hole should be provided which is connected to a tank with PVC pipes so that the Vermi wash can be utilized as liquid manure. Percent recovery of

compost will be 65%. The compost should be sprinkled with sufficient quantity of water as and when moisture level reduces below 40 %. For this, once in 4 days the water should be sprinkled so that the biomass always in wet condition. Nearly 750-Kg compost can be obtained from 1000-kg cashew recyclable biomass. The vermi compost contained 1.21 % N, 0.898 % P, 0.59 % K, 2.75 % Ca, 0.82 % mg, 29.66ppm Zn, 24.26 ppm Mn, 12.23 ppm Cu and 162ppm Fe. Population of useful bacteria, Fungi, actinomycetes, azospirillum are 39 x 10^6 , 39X10^5, 28x 10^5, and 0.52x 10^4 cfu (colony forming units) respectively (Yadukumar, 2007).

Nutrient management in organic farming

In the case of high density planting system it is proved beyond doubt that the recommended doses of nutrients are not required 6/7 years after planting since the crop canopy increases every year and covers the ground completely when the age of the crop reaches 6/7 years. It is at this stage crop does not perform in terms of yield and every year if we add lot of external nutrients as per the recommended doses the result will be unwanted increased vegetative growth and overlapping of branches causing heavy shade and consequent decreased flowering and fruiting resulting decreased yield. In high density planting system the leaf deposit/unit area is more than two times compared to normal density planting system. This huge deposit of leaf litter and apples contribute natural build up of nutrients in soil, which serves as rich source of nutrients. Every year external nutrient application has to be reduced. Studies on Nutrient management indicated that 1/3rd of recommended doses will be enough for maintaining cashew plantation when grown in high density planting system

In view of growing demand for organically grown cashew, strategies need to be developed for organic farming. Some of the commonly available organic farming manures like poultry manure, farm yard manure (FYM), vermicompost, oil cakes, coir pith-organic manures mixture hold promise in Cashew in organic farming and the same is under investigation at this National Research Center for Cashew. There is high potentiality to utilize cow dung slurry in major cattle cow dung producing states. Approximate quantities of cow dung available in different States are given in Table-5.

In addition to the above manures, poultry litter, and oil cakes are also available in huge quantities in most of the States. Green leaf is in abundance in Kerala, Coastal Karnataka and Maharashtra, where mostly cashew is grown. The green leaf can serve as good organic manure to cashew. Green manure crops like glyricidia, pongamia can be grown very well under rain fed conditions on the border or inside cashew plantations to produce green manure. Approximate nutrient contents in each kind of organic manure are given in Table-6

While considering the quantity of nutrients available in soil the approximate quantity of manure (organic manure) required meeting the recommended dose of Nitrogen of 500g/tree is presented in Table.6. The recommended dose of Nitrogen has been arrived based on the trials conducted in various Research Stations. In organic manure availability of nutrients normally stretches for longer period and in addition the loss of nutrients through leaching is minimum. Hence we need not apply the quantity of organic manure to the extent of actual nutrients requirement, which we otherwise calculate, when we require applying in the form of inorganic manure.

Due to nutrient loss through seepage, runoff and denitrification, hardly 50 per cent of nitrogen and 75 per cent of the applied K_2O will be made available to the plants if we apply

these nutrients through chemical fertilizers whereas, such nutrient loss is negligible in the case of organic manures. Detailed study on this aspect need to be taken up for suggesting options to farmers like, the exact quantity of different organic manures to be applied/tree depending upon the availability of these manures in the respective local markets.

The quantity of organic manures mentioned in Table.7 will meet the full requirement of P_2O_5 and K_2O in all cases except in the case of green manure and groundnut cake. When groundnut cake and green manures are used, bone meal and wood ash may be suggested to supplement P_2O_5 and K_2O requirements if the farmer prefers producing cashew organically, which fetches almost 30 per cent increase in price.

Green manuring

Leguminous crops such as *Peuraria javanica*, *Calapogonia muconoids* and *Centrosema pubescens* and *Glyricidia maculata* enrich the soil nutrients, add organic matter, prevent soil erosion and conserve soil moisture. The seeds of these cover crops can be sown in the beginning of rainy season with a seed rate of 12 kg/ha in the interspaces of cashew orchard. Beds of 30cm x30cm are prepared in sloppy degraded soils by loosening the soil and mixing compost or cow dung. Then the seeds are sown in the beds should be covered by a thin layer of soil. Presoaking of the seeds in water for 6 hours ensures better germination. Fencing is necessary to avoid cattle grazing. In addition to utilization of recyclable cashew biomass waste glyricidia can be grown in the inter space between two rows of cashew and yearly with three cuttings 60kg green biomass of glyricidia can be produced which can be added to base of the cashew plant (Yadukumar *et al,* 2007). In one-hectare area cashew plantation nearly 7 tonnes of dried green biomass can be produced and applied to cashew that is equal to application of nearly 186kg N, 40 kg P_20_5 and 67 kg K_20/ha/year. This will meet entire nutrient requirement of cashew and it was found that the same yield could be achieved compared to the plot receiving recommended Package of Practices.

Inter and mixed cropping

Leguminous crops like horse gram, cowpea, and other crops like groundnut; tapioca, vegetable and fodder crops etc are grown as intercrops in cashew plantations. Out of the annuals, biennials, fruit crops and tree species when grown as inter/mixed crops pine apple has been found the best intercrop in cashew garden for the first 7 years (Yadukumar$_1$, 2007). Pine apple could be grown in the interspaces of two rows of cashew. Between two rows of cashew three trenches have to be opened across the slope between them and size of trench should be 1M width 0.5M depth and any convenient length. In each trench two rows pineapple suckers should be planted at 60 cm between rows and 40 cm between two suckers within a row. In each trench for 1 M length half basket of compost should be added and mixed with soil before planting pineapple suckers. One-hectare cashew orchard can accommodate 15,000 pineapple suckers. Pineapple starts yielding from 2nd year and from 4th year it should be replanted in a new trench dug out by the side of existing trench and the same can be retained till 7th year of cashew plantation. After seven years because of heavy shade of branches of cashew over the pineapple and due to difficulty in picking raw cashew nuts fallen over pineapple plants it may not be feasible to grow this intercrop economically. Nearly 40 tons of pineapple fruits can be expected for sven years with a net return of about Rs. 2 lakhs. Expenditure would be Rs. 1 lakh and hence net profit from pineapple alone will be Rs.1 lakh in one ha of cashew garden. Apart from gaining a net profit of Rs.1lakh from

pineapple 30 % increase in cashew nut production was observed mainly due to better soil and water conservation in trenches where pine apple is planted across the slope between two rows of cashew.

Other crops like turmeric, ginger and elephant foot yams can be grown as intercrops organically for the first 5 years of cashew plantations. The profit realized from these crops may range from Rs. 20,000 to 50, 000/ha

Ample scope is there to grow vanilla and pepper as mixed crops with cashew if irrigation facility is provided. *Garcinia indica (kokum)* can be grown as mixed crop by maintaining same population as that of main crop-cashew (200 each/ha). All the above crops are grown organically as mixed crops.

Weed management

Generally weeding in cashew can be done twice a year. One weeding in the month of august during manure application and another weeding can be done just before the start of flushing and flowering (October or November). The weed biomass can be effectively recycled as that of cashew biomass waste explained earlier.

Management of Tea Mosquito Bug (TMB)

Tea mosquito bug can cause yield reduction to the tune of 30-40% by damaging tender shoots, inflorescences and nuts. Both adults and nymphs of TMB suck the sap from tender shoots, panicles and immature nuts and apples which results in formation of black lesions. These lesions on shoots and panicles coalesce causing shoot blight or blossom blight. The plants can escape TMB attack if the new flush is delayed. Planting mid season or late season flowering varieties would be the right strategy to escape TMB. Even early flowering varieties also flower 10-15 days late if the plants are grown organically compared to chemical fertilizer applied ones (Table-8). The delay in flowering naturally minimizes the incidence of tea mosquito by escaping multiplication of tea mosquito population. Clean cultivation is another method to check multiplication of TMB considerably. All weeds should be removed and heaped as mulch Encouraging multiplication of weaver ants (*Occoyphylla smargdina*) checks the TMB. The red ants also feed on the nymphs of the tea mosquito bugs. In the initial stages placing small pieces of jaggery at the cracks and crevices of the bark can attract the red ants

At National Research Centre for Cashew, plot of 2.5 hectares is maintained for the last 4 years and here though initially the Tea mosquito damage was noticed in small pockets, no economic loss of yield was observed. Studies on the effect of various organic pesticides like Pgalada, Phytozeal and phalini in late variety-NDR2-1 indicated that combination of Phytozeal and phalada resulted in maximum yield with minimum Tea Mosquito damage (Table-9). Phalada IIIc1 is a herbal based liquid insecticide certified as 100 % organic insecticide by Skal International (Certifying agency based at Netherland). The contents of this herbal preparations are combination of water and extracts of *Saptora japonica* roots (2%), *Annona reticulata* seeds (15 %), *Adathoda vasaka* (leaf-12 %)), *Sapindus trifolatus* (30 %), *Pongamia pinnata* (20 %). Phytizeal is a herbal based liquid insecticide combined with vermiwash which served as good nutrient source also. Phytozeal contained vermiwash (90 %) Plant extracts of *Lantana camera* flower (0.%), *Cynadon dactylon* grass (0.5 %),

Seaweed (5 %), *Calotropis procea* (2 %) and extracts of *Pseudomonas fluorescence* (0.1 %) and *Trichoderma viridae* (0.1 %). Phalini is diluted form of cashew nut shell oil mixed with water. In another observational trial it was found that tea moasquito damage score is more in both Bhaskara and Ullal-3 variety in conventional farming compared to organic farming (Table-10)

Management of Cashew Stem and Root Borer

Older cashew trees are more prone to infestation by CSRB. Adult female beetles lay eggs in the bark crevices of the stem (near to the collar region) or on the exposed roots. After hatching, the young grubs tunnel immediately into the bark of the trunk or root regions. Due to extensive feeding by irregular tunneling in the bark, the translocation of the nutrients is hampered leading to drying of leaves and twigs. In the infested portions the gum and frass (chewed fibres and excreta pellets) start oozing out from the tree, which is the initial symptom of pest attack. Curative measures should be taken up immediately which are given below.

The infested portion having frass below the bark on either the main stem or root portion (after suitably digging the soil to a depth of 2 ft) should be carefully chiseled to inflict minimum damage to the bark and tunnels should be tracked towards the fresher frass to locate the CSRB grubs, which should then be removed and killed. In case, white powdery fibres are seen it indicates that the grubs have entered to the heartwood for pupation. In such cases a pliable wire (for example automobile gear wire) should be inserted deep into the pupation hole and pushed in till a slushy sound is heard/milky white fluid flows out indicating damage to the grub or pupa. Later chiseled portion of the bark should be swabbed with 10 % Bordeaux paste. When a paste of cow dung and ash is applied to the injured portion of the bark it helps in curing of wounds.

Trees having more than 50 % of the bark circumferences damaged by insect or with yellowing of the canopy hardly ever recover. However, the existence of different pest stages in such trees will act as inoculums for the next season. Hence phyto-sanitation should be adopted by uprooting such trees, which are beyond recovery and disposed off immediately, along with removal of pest stages in other infested trees to prevent build up of pest inoculums. As the pest incidence occurs during the period of nut collection (Feb-May) the infested trees can be marked and curative measures must be adopted immediately, so that the grubs do not inflict more damage.

Yield

In the experiments conducted at National research Centre for cashew, Puttur on the organic farming the yield realized was to the tune of 1-1.3 tonne per hectare (Table-11 & 12) under high density planting system in the second harvest (4years old plantation).

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Table-1: Approximate quantity of nutrients available in soils of different zones (Nutrient kg/ha)

	N	**P_2O_5**	**K_2O**	**Nutrient status**
Coastal Karnataka	120	3 - 43	100	Low to high in N, Low to high in P_2O_5 and low in K_2o
Coastal Kerala	60 – 120	6 – 13	186– 345	Low in N, Low to medium in P_2O_5 and medium to high in K_2o
Maharashtra	156– 479	07 – 2.12	79 – 208	Low to medium in N, Low in P_2O_5 and medium to high in K_2o
Andhra Pradesh (Bapatla)	54 – 71	4 – 6	150-190	Low
Orissa	38-80	15-28	100-150	Low in N, medium to high in P_2O_5 and medium in K_2o

(Source: Collected from reports of AICRP on Cashew)

Table 2: Fertilizer nutrients recommendation in different states (g/tree/year)

States	**N**	**P_2O_5**	**K_2O**
Karnataka	500	125-250	125-250
Kerala	750	325	300
Maharashtra	500	250	250
Andhra Pradesh	500	250	250
Orissa	500	250	250

Source: Annual Report 1997-98, AICRP on Cashew/Cashew Production Technology, NRCC

Table 3: Influence of organic and inorganic manure coupled with soil and water conservation techniques on nut yield of 13 years old cashew orchard (kg/ha)

Treatments	Sub plot treatments			Mean	% of control
	1	2	3		
Individual tree base terracing with catch pit	818.5	946.7	1068.3	944.5	145.2
Individual tree base terracing with crescent bund	1051.1	1212.3	1261.7	1175.0	180.6
Staggered trenches between two rows	831.1	1128.9	1032.0	997.3	153.3
Control plot without any soil and water conservation	560.4	614.4	776.4	650.4	100
Mean	815.3	975.6	1034.6		
CD (0.05) for Soil conservation measures CD (0.05) values for manures CD (0.05) values for interaction	289.75 65.47 NS				

NB: 1=Control (No manure application), 2=Recommended doses of fertilizers (500g N 125 g P_2O_5, 125 g K_2O /tree + 10 kg poultry manure/ tree/ year), 3=20 kg poultry manure

Table 4: Effect of manurial doses on yield five and six years after planting

Treatments (g/tree/year)	Nut yield (kg/ha)		
	5YAP	6YAP	Total for 2 years
No fertilizers	228	669	877
100% N RFD	243	951	1194
Azospirillum+100% N-RCB	206	1053	1259
Azatobactor+100 % N-RCB	212	831	1043
25%N RFD+75 % N-RCB	112	942	1054
50%N RFD+50% N-RCB	300	1024	1324
75%N RFD+25% N-RCB	247	1031	1278
25%N RFD+75%N-PM	258	795	1053
50%N RFD+50%N-PM	315	718	1033
75%N RFD+25%N-PM	222	989	1211
CD for manurial doses		546	

RFD = Recommended Fertilizer Doses. RCB = Recyclable Cashew Biomass available in garden. PM=Poultry Manure. YAP=Years After Planting

Table 5: Annual out turn of wet dung from Cattle and Buffalo (in million tones) and nutrient potential of bovine excreta

States	Million tons of cow dung
Andhra Pradesh	77.389
Kerala	4.538
Maharashtra	107.986
Karnataka	54.806
Tamil Nadu	70.027

(Source: Gaur *et al, 1992.* – Organics in soil health and crop production, Edited by P .K Thampan.

Table 6: Nutrient status of organic manure (g/kg of manure)

Manure	N	P_2O_5	K_2O
Poultry manure	28.7	10.3	13.0
Farm Yard Manure (FYM)	8.0	4.1	7.4
Vermicompost	16.0	22.0	6.7
Green Manure Glyricidia	39.8	7.1	11.8
Cashew waste compost or compost of recyclable cashew biomass	10.5	5.3	4
Biogas slurry	18.0	9.2	8.0
Water Hyacinth compost	20.0	10.0	23.0
Castor cake	58.0	18.0	16.0
Groundnut cake	78.0	15.0	14.0
Pongamia cake	34.0	10.0	12.0
Neem cake	52.0	10.0	14.0

(Source: Organics in Soil Health in Crop Production 1993 by PK Thampan, Pee Kay Tree – Crop Development Foundation, Cochin)

Table 7: Quantity of organic manures required by adult cashew tree (kg/tree)

Manure	Quantity (kg/tree) required	Nutrients supplied g/tree)		
		N	P_2O_5	K_2O
Poultry manure	17.4	500	180	226
Farm Yard Manure (FYM)	62.5	500	256	462
Vermicompost	31.3	500	689	210
Green Manure i) Glyricidia	12.5	500	89	183
Biogas slurry	27.8	500	256	222
Water Hyacinth compost	25.0	500	250	575
Castor cake	8.6	500	155	138
Groundnut cake	6.4	500	96	90
Pongamia cake	14.7	500	147	191
Cashew waste compost	33.0	500	250	200
Neem cake	9.61	500	96	134

(Note: Calculated based on nutrient concentration available in each kind of manure as worked out at NRCC)

Table-8: Time of flowering in different varieties during 2007-08 (50% completion of flowering)

Varieties	Organic farming	Conventional farming
Bhaskara	Dec.2nd week	Nov.4th week
Ulal-3	Dec.2nd week	Nov.4th week
VRI-3	Nov..3rd week	Nov.1st week
Madakkathara-2	Jan.1st week	Dec. 3rd wek
K22-1	Jan. 3rd week	Jan. 1st week
NRCC Selection 2	Nov. 3rd week	Nov.1st week

Table-9: Effect of organic pesticides on the performance of four years old cashew tree (Madk-2)

Treatments	Yield (kg/tree
Phytozeal 5.0 ml/l + phalada IIIC 1.0 ml/l	**3.07**
Phytozeal 7.5 ml/l + phalada IIIC 1.5 ml/l	**3.52**
Phytozeal 10.0 ml/l + phalada IIIC 2.0 ml/l	**4.17**
Phalini (1:30) + Phytozeal 5.0 ml/l	**3.03**
Phytozeal 5.0 ml/l	**3.15**
Control	**1.81**

Table-10: Tea mosquito damage score in different farming systems.

Varieties	Organic farming	Conventional farming
Bhaskara	0.21	0.51
Ullal-3	0.30	2.10

Damage score (1-4), 1 = least damaged, 4 = severely damaged (panicle completely dried)

Table-11: Yield performance for the first four years under organic farming (Mdk2)

System of planting	3rd year	4th year
HDP with irrigation	2.9 kg/tree 1200 kg/ha	3.38 kg/tree 1352 kg/ha
HDP- without irrigation	2kg/tree. 800kg/ha	2.5kg/tree 1000 kg/ha
NDP-with Pineapple	3.2kg/tree 640kg/ha	4.7 kg/tree 940 kg/ha
HDP with turmeric	1.37-kg/tree 548-kg/ha	2.83 kg/tree 1132 kg/ha

Table-12: Variety wise performance of cashew grown organically up to second harvest (4th year)

Variety (HDP)	3rd year, Kg/ha	4th year, Kg/ha
Ullal-3	710	1208
Ullal-2	638	1064
Sel-2	546	544
Bhaskara	506	1212
VRI 3	593	1300
V4	284	1200
Dhana	206	1088
Kanaka	313	1092
Madakkathara2	256	1288
K22-1	273	1432
Priyanka	330	1244
Ullal4	250	1028

REJUVENATION OF SENILE CASHEW ORCHARDS

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Cashew (*Anacardium occidentale* L.) plants at a closer or wider spacing during later years get competition from neighbouring ones for sunlight and slowly start drying resulting into dead wood. Of late, only the top portion of the canopy remains exposed to sunlight and thus slowly trees go senile. Cashew also a fast growing woody perennial is characterized by spreading branches. Canopy of cashew tree gains irregular shape due to its irratic branching habit. Plantations having trees of irregular canopy shape and size are difficult to manage which makes plants to become poor nut yielders in the later years as the lower branches of canopy gradually die and become empty. In India majority of the older cashew plantations are of seedling origin of non-descript material and have poor genetic potentiality and also have gone senile due to poor management practices. Cashew requires more sunlight for its growth and fruiting.

In the past cashew was raised only in degraded and low fertile soils by soil conservation departments, plantation corporations, forest departments and also by famers for the purpose of soil conservation and afforestation. The non adoption of other cultural management practices too lead to poor growth and production from such plantations. Such plantations now have gone senile and there is some scope of improvement through rejuvenation provided subsequently they are managed well. If such plantations are of improved varieties having good genetic potentiality such plantations can be rejuvenated by limb pruning or if they are genetically low yielders they need to be top worked by beheading and grafting with better material for improving the yield performance.The other plantation management practices such as manuring, timely weeding and plant protection are also equally important for rejuvenation of such old plantations. Following some of the agronomic / cultural practices of plantation management can help in rejuvenating / improving the senile orchards.

Soil and water conservation measures

Most of the existing senile plantations are raised primarily to create vegetational cover as a measure of soil and water conservation by the forest departments (Orissa, Kerala and Karnataka). Such afforested areas with cashew cover should be treated as commercial plantations. But due to their existance in the unduating topography, the rain water has free run off and there by making the plantations to starve for moisture during summer season. In order to reduce subsoil moisture stress during summer, in west coast soil and water conservation measures, such as terracing the base of the plant , opening catch pits, terracing with crescent bund and opening pits in the middle of four plants across the slope or opening trenches of one metre width and half metre depth and any convenient length beteen two rows of cashew and burrying the coconut husk can be adopted to with hold water for longer period particularly during the pre and post monsoon showers. In east coast intercept bunds of 100 cm x 50cm x 30cm size are prepared in the cashew plantations. This bunding apart from breaking the velocity of runoff water it helps to impound rain water. Such impounded water in disc ploughed or raked soils, is helpful during summer months.

Application of manures and fertilizers

Poor yields obtained in majority of the existing senile cashew plantations could be partly due to non replenishment of soil nutrients and partly due to washing away of fertile top soil through flash run off. Sometimes nutrient drain takes place due to removal of leaf litter from the plot every year. In senile plantations annual availability of leaf litter itself is to the tune of 3.5 to 5 tonnes / ha (Kumar and Hegde,1999). These leaf litters are generally collected during peak summer season which coincides with picking (harvest) of fallen nuts. Generally just before picking of nuts the ground area is cleared by removing the leaf litter. The same biomass can be decomposed or burnt and the material can be used for manuring the cashew plantations which may meet almost one-third of the requirement of plant nutrients. The pit size can be 1M width, 1M length and 0.5M depth can be dug in the centre of four plants and the waste material can be decomposed *in situ*. This pit will act as catch pit for soil and water conservation.as well as compost pit. Before the onset of rainy season the leaf and apple biomass are collected and applied to this pit. With the receipt of premonsoon showers (one or more showers) nearly 20 % of the weight of biomass waste is applied with cow dung slurry and mixed thoroughly. Later the pit is covered with thin layer of soil.

The biomass in the compost pit undergoes decomposuition through out the rainy season and the compost will be ready towards the end of the season. During the rainy season 2 to 3 times turning of the biomass materials will further enhance decomposition in the pit. Generally there is a practice of appplication of fertilizers and manure at the base of the tree by opening circular trenches at 2m distance. While doing so some of the thick roots are cut in grown up plantation. Wounded roots attract cashew stem and root brer (CSRB) and there is likely hood of severe infestation later killing the trees. In such plots it is advisable to apply manure in pits dug out in the middle of four trees where thick roots are not found and in the same pits cashew biomass waste is also added which will decompose during the reainy season if we follow the above procedure of composting. The research results indicated that nearly 3.5 t/ha composts can be obtained from 5.5 t/ha cashew biomass waste available annually. This means, in terms of nutrient gain 36 kg N, 5 kg P and 16 kg K / ha in addition to considerable quantities of micronutrients and beneficial microorganisms if applied to the plantation in the form of compost (Yadukumar and Nandan,2005). This will be sufficient to meet 46 % N and 25 % of P and 13 % of K requirements annually in addition to sufficient quantities of micronutrients and beneficial microorganisms.

Consolidation of plantations by gap filling/replanting

At present all the old senile plantations have only 40-50% plant population due to the death of trees by CSRB infestation or other causes. Through gap filling with high yielding clones in these plantations can be consolidated and productivity can be increased . If the gaps are more than 50 % replanting with grafts of high yielding varieties may be taken up in phased manner , so that the level of production does not come down drastically. Such a replanting progamme is suggested in the states of Karnataka, Goa, Tamilnadu and Orissa.

Supplementary irrigaton

It is well proven that supplementary irrigation during fruiting season can enhance nut yield in cashew. But everyhwere water may not be available. and not possible to adopt on a large scale. The irrigation can be provided to the trees which are grown in homestead gardens

where the water is available. Two or three irrigations depending on the availability @100-200 litres of water per tree was found to double the yield in a 12 year old plantations (Yadukumar and Mandal, 1994).

Rejuvenation of old trees by pruning

The normal optimum spacing recommended for cashew is 8m x 8m. There is overlapping of canopy, in 8 to 10 years of age depending on the nature of variety unless the canopy is maintained by trimming and thinning. The research results have indicated that simple removal of dead wood, criss cross branches water shoots etc. allows better penetration of light and this has doubled the yield. Therefore in the old and neglected plantations this operation need to be taken up. Manipulation of canopy size and shape by means of pruning and training for its containment and for better yield performance was not felt as an necessary orchard management technique for cashew in earlier days. Plantations which have overlapping branches will lead to dead wood development and decline in yield in the later years. Such plantations can be rejuvenated through canopy redevelopment by limb pruning (Nayak et al., 2008).

The redevelopment of canopy is necessory in the older plantations, where the canopies are over crowded resulting in reduction in yield. This is possible by heading back (limb pruning) the exhausted canopy at 1.0 - 1.50 m height. Immediately after beheading the trees, the prunned wood needs to be removed from the plot so as to prevent the damage by shot hole borers. Remaining portion of the trunk and exposed part of roots is to be swabbed with 0.2 per cent chlorpyriphos at least 2-3 times after beheading till new canopy is developed. Regular checking for the damage by Cashew Stem and Root Borer (CSRB) is to be done and managed. The cut ends of the branches should be smeared with 10 per cent bordeaux paste to prevent the gummosis and entry of any pathogens. The best season for limb pruning is May-June i.e., immediately after the harvest of the annual crop.

The new flushes arise from the dormant buds on the trunk. These new sprouts form the canopy within a period of 6-7 months depending on the variety (Fig. 1 to Fig.2). Yield levels during the first season after pruning are slightly lower while the yield from second season onwards is better than the unpruned plants (Fig. 3 & 4). Yield performance of the 4 varieties during first 2 years after limb-pruning is given in Table 1. It was also observed that cashew varieties such as Ullal-1, Ullal-2, Chintamani-1, K-22-1, NDR-2-1, Kanaka, V-4 and NRCC Sel-2 responded well to limb pruning. The cashew trees after rejuvenation either by beheading or top working are more vulnerable for CSRB attack. The old cashew plantations can be only rejuvenated as explained above, provided they are managed well by taking care of individual plants to prevent damage by CSRB (*Plocaederus ferrugineus)*.

Table 1. Effect of limb pruning on yield of cashew

Treatment	**Yield (Kg/tree)**	
	1st year after pruning	**2nd year after pruning**
A: Variety		
VRI-1	1.62	3.19
Ullal-1	2.95	4.42
VTH 30/4	1.18	4.61
NRCC Sel-1	0.72	1.23

Good phytosanitation procedures are to be adopted to manage the rejuvenated plants. The newly developed canopy needs to be protected from Tea Mosquito Bug (*Helopeltis antonii)* and leaf beetles as they are also more vulnerable for the damage in the initial 5-6 months of canopy development. Care should also be taken to treat the cut wounds with 10 per cent bordeaux paste during the beginning of monsoon season to prevent from any fungal infection and gummosis. If the plants are properly protected the canopy redevelopment can help in enhancing the nut yield to the fullest potential of the plant after 2-3 years. The limb pruned trees be pruned or trimmed as and when requierd in subsequent years. It may be noted that the yield levels of limb pruned trees are much better than the freshly planted cashew grafts of comparable years due to better root system. Pruning operation should be taken up only after complete picking of nuts which coincides with temporary quiscent stage (May-June in West Coast) in cashew (Nayak, 1996, 2007).

Rejuvenation by Top Working

Rejuvenation of old and unthrifty cashew trees by topworking, by grafting with scions of better variety has been developed in early eighties at Agricultural Research Station, Ullal, under University of Agricultural Sciences, Bangalore (Rao, 1985; Guruprasad et al., 1988; Khan et al., 1988) and subsequently modified as per local requirement and popularized by National Research Centre for Cashew and several other cashew research centres in the country.

Though the topworking is a promising technology to rejuvenate the old senile plantations of seedling progeny in a short period, the technology could not be adopted on a large scale due to the problem of CSRB which damages and kills the topworked trees. The technology is being recommended only for the homestead gardens of young age which can be properly monitored and maintained.

Conditions and Points to be considered before top working:

- Age of the tree: Tree should be within 15-20 years age. As far as possible it should have smooth bark and should not have many crevices on the bark at collar region. The colour of the trunk should be brown or ash coloured and not black coloured.

- Trees should not have been damaged by cashew stem and root borer (CSRB): Either the trunk portion or exposed root portion on the ground should be free from stem borer damage. The symptoms of CSRB can be ascertained from the oozing of gum or the powdery mass (frass) fallen near the entry point of CSRB.

- Trees should be healthy enough with spreading lower branches. It should have well developed root system and should have capacity to cope up with the growth of the new canopy. It should be free from other pest and diseases.

Method of Top working

Top working involves two steps (i) beheading of the tree to be top worked and (ii) grafting with a elite material on the new flushes emerging out on the stumps of beheaded tree.

Beheading of the tree

The most suitable time for beheading of the tree is April-May i.e. immediately after the harvest of the crop in West Coast region. It also depends on the fruit bearing pattern of the tree (early, mid and late season) in different varieties. After selecting the tree for beheading, cut the limbs and reduce the weight of the crown and finally retain the stumps of plants at 1 – 1.5 M height (Fig.1). While pruning the limbs, care should be taken so that the bark should not have split or damaged on the retained stump. Immediately after the beheading of the tree treat the cut wounds with 10 per cent Bordeaux paste so that there should not be any gummosis and fungal infection in the wound. After beheading tree the cut plant material should be cleared from the site immediately to prevent the harbouring of pathogens and insect pests.

Grafting

Grafting of new flushes emerging from the trunk of the cut tree can be taken up after 45 to 60 days onwards (Fig.5). About 200-300 shoots emerge from the trunk below the cut end depending on the size of the remaining trunk. On a cut tree about 15-20 shoots of different branches in different directions may be selected and grafting by softwood grafting technique may be taken with the scion material of required or elite varieties (Fig. 6). The period between June to August is most suitable for top working under west coast region. After successful grafting of the shoots remaining ungrafted shoots need to be gradually removed in a phased manner. After about 4-5 months of grafting only about 10-12 successful grafts in different branches in different directions may be retained and rest may be removed. The new flushes emerging from the trunk subsequently also be frequently removed (Fig.7). Initially grafts or shoots may be protected from damage by wind and animal by providing staking and support with sticks. From second year of grafting, the plant will grow into a tree and give flowers and fruits like a normal tree (Fig.8).

In one of the experiments conducted at NRCC on top working, very good success was recorded. In a plantations of young trees of 8 years age of variety Vengurla-2 when top worked with the scion of Vengurla-4 to replace the variety in scion bank, 88 trees out of 94 top worked trees could be successfully saved and managed.

The expenditure involved and the yield performance for initial two years is furnished in Table 2. Studies on large plot trials of topworking conducted both at NRCC and Karnataka Cashew Development Corporations, revealed that utmost care is required to protect the topworked trees from the cashew stem and root borer.

Table 2. Performance of 94* top worked trees; expenditure involved in top working and maintenance.

Year	Expenditure involved in top working and maintenance (Rs)	Nut yield per plot (kg)	Income per plot (Rs)
1996-97	3098	-	-
1997-98	2688	37.8	1512
1998-99	2756	184.2	8389
Total	8542	222.0	9801

* Out of 94 trees top worked 88 trees survived
Yield and income are from plot of 88 survived trees

Pest management in the rejuvenated trees

The trees which have been top worked need to be checked for any symptoms of CSRB pest incidence right from the first week after top working at 15 days intervals. Normally the fork regions and the cut ends (if uncovered) will have the pest entry and exudation of the fine frass material in small quantity. These spots of the bark should be chiseled cautiously so as not to make more damage onto the bark of the top worked trees and the tunnel made by the grubs, which bore into the bark, can be traced out by the freshness of frass. The young grubs remaining inside need to be removed out and killed. In case the frass comes out from the root zone then the soil at that spot need to be dug out and the infested root needs to be checked for the grubs which are normally found in the underside (ventral) portion of the roots.

The direction in which the grub has moved in both the stem and root can be made out by the freshness of frass wherein the older frass is dark brown and the fresh frass will have reddish colour. In case the grubs are not removed when they are young they damage the bark severely and later enter into the heartwood during which time the frass comprises of whitish fibrous powder. The grubs have to be killed under these situations using a pliable wire or gear wire as the tunnels will be zigzag in nature. A slushy sound is heard as soon as the grubs get poked with the wire and the body fluid oozes out of the tunnel.

The chiseled surface needs to be treated using either carbaryl suspension (1.0%) or chlorpyriphos solution (0.2%). Repeated infestation of treated top worked trees is not uncommon. Hence constant vigil of these trees and those immediately next to it is of utmost importance during the months of Jul. to Nov. when the symptoms of infestation like frass and yellowing of the shoots is noticed. In certain cases where water logging occurs at the collar region the bark starts rotting at the collar region and the tree likely be attacked severely by the shot hole borers. In such cases, there is an immediate need for treating such trees by swabbing and drenching with monocrotophos (0.2%) (approx. 2-4 lts per tree)as such trees will lead to spread of infestation to the neighbouring trees in a short time.

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REJUVENATION OF SENILE ORCHARDS BY LIMB PRUNING

Fig.1. Limb pruned tree of exhausted canopy

Fig.2. View of limb pruned trees after three months

Fig.3. Flowering in limb pruned tree

Fig.4. Fruiting in second year in limb pruned tree

REJUVENATION BY TOP WORKING

Fig.5. Flushing in beheaded tree for top working

Fig.6. Initial stage of top grafting

Fig.7. Successfully top worked tree

Fig.8. Two year old top worked plant

CASHEW BASED CROPPING SYSTEMS

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Introduction

Cashew takes 8 to 10 years for the canopy to cover the entire area under normal spacing and there is good scope in providing high returns to farmers by adopting intercropping. In hilly regions there is a possibility of soil erosion, nutrient losses and weed growth during initial years of planting. Intercropping is the best option to minimize erosion, nutrient losses and conserve soil and moisture and to realize higher returns from unit area during the early stages of cashew plantation. Pineapple can be grown as a suitable intercrop between two rows of cashew for the first seven years. The spacing to be maintained for cashew is 8m x 8m (156 trees/ha) or 7.5 m x 7.5 m (175 trees/ha) or 10 m x 5 m (200 trees/ha). Growing pineapple in trenches across the slope between two rows of cashew helped to conserves the soil moisture, which in turn increased the yield of cashew (main crop) by 1.5 times compared to cashew alone. Pineapple can be grown as a profitable intercrop under irrigated as well as rainfed conditions in west coast region (Yadukumar *et al.,* 2003). Maize and groundnut can be grown successfully as intercrops in newly planted and two years old cashew orchards (Abeysinghe *et al.,* 2003). Other crops such as Tapioca, Turmeric, Ginger, Cucurbits, Colocasia and Elephant Foot Yam have been found to be suitable intercrops in West Coast region while Colocasia, Brinjal, Groundnut, Blackgram were found to be good intercrops in East Coast region. Weed suppression was best in plots carrying cashew / cassava and cashew / plantation / cassava mixtures with a 50-60% reduction in the frequency of weeding per annum (Adeyemi, 1998).

The term *cropping system* refers to the crops and crop sequences and the management techniques used on a particular field over a period of years. This term is not a new one, but it has been used more often in recent years in discussions about sustainability of our agricultural production systems. You can choose from many different types of crops, and you can plant them in different combinations.

Allelopathy is the release of a chemical substance by one plant species that inhibits the growth of another species.

Double-cropping (also known as sequential cropping) is the practice of planting a second crop immediately following the harvest of a first crop, thus harvesting two crops from the same field in one year.

Intercropping is the presence of two or more crops in the same field at the same time arrangement that results in the crops competing with one and another.

Monocropping, or **monoculture,** refers to the presence of a single crop in a field. This term is often used to refer to growing the same crop year after year in the same field; this practice is better described as *continuous cropping*, or monocropping.

Relay intercropping is a technique in which different crops are planted at different times in the same field, and both (or all) crops spend at least part of their season growing together in the field. An example would be dropping cover-crop seed into a soybean crop before it is mature.

Strip cropping is the presence of two or more crops in the same field, planted in strips such that most plant competition is within each crop rather than between crops.

Advantage of Intercropping

- Intercropping gives additional yield income/unit area than sole cropping.
- It acts as an insurance against failure of crops in abnormal year.
- Inter-crops maintain the soil fertility as the nutrient uptake is made from both layers of soil.
- Reduction in soil runoff and controls weeds.
- Intercrops provide shade and support to the other crop.
- Inter cropping system utilizes resources efficiently and their productivity is increased
- Intercropping with cash crops is higher profitable.
- It helps to avoid inter-crop competition and thus a higher number of crop plants are grown per unit area.

Disadvantages of intercropping

- Yield decreases as the crops differ in their competitive abilities.
- Management of different cultural practices seems to be difficult task.
- Improved implements cannot be used efficiently
- Higher amount of fertilizer or irrigation water cannot be utilized properly as the component crops vary in their response of these resources.
- Harvesting is difficult.

Challenges in cropping systems

Pests and diseases*:* Certain insect pests and diseases may spread easily from one crop to the next through the crop residues. Avoid crop combinations where this is a problem.

Markets

Markets do not always exist for new crops you may want to plant as part of your rotation. It may be hard to find seed, you can't find anyone to buy the yield, or prices are too low to make it worthwhile growing the crop.

Knowledge, skills and labour

Managing rotations properly requires more skills than a single crop. It also needs work at different times of year. People may be reluctant to try out new crops because they are not used to growing or eating them.

West Coast

Pineapple as intercrop

Pineapple can be grown as an intercrop in cashew garden profitably for the first 7 years. Both main and intercrop can be planted simultaneously. Normally pineapple can be grown in the inter spaces available between two rows of cashew plants planted at 8m x 8m (156 trees/ha) or 7.5 m x 7.5 m (175 trees/ha) or 10 m x 5 m (200 trees/ha). Pineapple is planted with the onset of pre-monsoon showers in three trenches dug out at 90 cm distance across the slope between two rows of cashew. In leveled land straight trenches can be opened between two rows of cashew. Each trench is of 1 m width, 0.5 m depth and convenient length. Pineapple suckers with 8-15 leaves are planted in each trench in two rows at 60 cm apart. The distance between two plants within a row is 40 cm. Before planting pineapple suckers the trench should be half filled with mixture of top soil, farm yard manure and rock phosphate. Nearly 2.5 kg of farm yard manure and 160 g of rock phosphate/metre length of trench should be added and thoroughly mixed. Fertilizers should be applied annually in two split doses (May-June and September-October). Fertilizers are applied at the rate of 25 g N, 7 g P_2O_5 and 25 g K_2O/pineapple sucker/year. Each time whenever fertilizers are applied in September-October period, earthing up of soil at the base of suckers in each row is done after weeding. This operation is most important for pineapple for better anchorage in addition to better rooting. Nearly 35% of the plant population yields in the second year itself. Remaining 65% yield can be realized during the subsequent years. In the fourth year replanting of pineapple should be done in the freshly opened trenches at the adjacent areas between the two existing trenches.

Pepper as inter / mixed crop

Trailing pepper on the stem and branches of grown up cashew trees (more than 6 years) is also adopted. Separate application of manure is necessary for pepper vine. With the onset of monsoon, pit size of 45 cm x 45 cm x 45 cm should be opened about 45 cm away from the cashew tree at the base and pits should be filled with top soil, 200 g rock phosphate, 200 g lime and 0.5 kg neem cake. Rooted pepper cuttings should be planted during June with the onset of monsoon (South-West Monsoon season). Once the vine establishes and starts growing, the vine should be tied to the stem of the tree at the base with jute thread. This practice should continue till vines grow to almost 1.5 m height all around the stem surface of the cashew tree. Cashew stem girth will be around 30 cm when it is 6 years old and because of the rough stem surface of the cashew tree, pepper vine easily clings to the plant and spreads to all the remaining thick branches. This actually when exposed to filtered sunlight through cashew canopy, it flowers profusely during rainy season. From second year onwards regular application of recommended doses of fertilizers in split doses to pepper (100 g N, 40 g P_2O_5 and 140 g K_2O g/tree/year) at 45 to 60 cm away from the base results in better growth and yield.

Ginger as intercrop

Ginger can be grown as an intercrop in the initial 3 to 4 years of cashew plantation. Particularly this is more suitable in the interior areas of west coast on hillocks with forest surroundings. Whenever forest surroundings are noticed growing ginger in the initial years before taking up regular plantation is a common practice in west coast region. With the onset

of pre-monsoon season (April-May) raised beds of 2.5 m length, 1.5 m width and 0.25 m height should be prepared across the slope between two rows of cashew. With this operation all the jungle growth including small bushes will be removed and soil is loosened. Loose and made up soil present in the raised bed, acts as good soil and moisture conservation structure which also facilitates better penetration of cashew roots. Even the weeds will be controlled while preparing beds for ginger. Approximately 10 quintal disease free ginger rhizomes are required as seed material for planting one ha. Rhizomes of ginger should be planted in raised bed at 10 cm distance from one planting spot to another spot.

Farm yard manure or compost at the rate of 15 t/ha has to be applied initially to the bed after planting ginger rhizomes. Soon after planting; thick mulch has to be applied at the rate of 10 t/ha. Application of heavy mulch is necessary to conserve moisture during pre-monsoon and later to avoid soil erosion during rainy season. Heavy mulch also is necessary to conserve moisture soon after the cessation of rain so that this will continue for another 3 months without necessitating irrigation. Ginger crop is of 7 to 8 month duration and harvesting can be done in the month of January. Total cost of cultivation includes items like clearing of jungle, raised seed beds, cost of ginger seed rhizomes, application of FYM and weeding and mulching. One can expect a yield of around 60 quintals ginger per hectare. In the subsequent 2 to 3 years, part of rhizomes removed from the previous crop can be utilized as seed material each year and to that extent the cost of cultivation is reduced. Ginger is prone for deadly disease Rhizome rot, which needs proper care.

Fodder and legume forages

Experiments conducted at Agricultural Research Station, Ullal revealed that among the fodder crops as intercrops, NB-21 grass gave the highest green fodder yield (41.9 t/ha) over Guinea grass (27.6 t/ha) and para grass (18.0 t/ha). Among legume fodders, *Sonthus hamata* ranked first in green fodder yield (12.55 t/ha) followed by *Mimosa invisa* (10.25 t/ha) and *Lupinus* spp. (7.28 t/ha). The unutilized interspace of cashew in coastal Karnataka was successfully exploited for 1st three years of plantations by growing fodder and grasses like NB-21, Guinea grass and para grass with NB-21 yielding highest green fodder of 21 t per ha (Chalapathi, 1989).

Andhra Pradesh

At Bapatla, groundnut, green gram and black gram can be grown as inter crops in rabi season. Groundnut recorded a maximum yield of 1400 kg/ha and had higher cost benefit ratio (1:1.96). Horsegram as an intercrop resulted in net profit of Rs.19900/- with a cost benefit ratio of 1:1.80 (Table 7). Whereas, inter cropping with flower crop like marigold with cashew recorded the highest net profit of Rs.65, 967/- per hectare (Table 8). During the year 2011-12, cluster bean, marigold, amaranthus and mesta were grown as intercrops. Cluster bean recorded maximum yield of 9097 kg/ha and gave higher cost benefit ratio 3.7 and led to maximum net returns of Rs. 94,002/-. In the West Godavari district, cashew is grown in combination with *Casuarina* and coconut.

Tamil Nadu

Among field crops, pulses and oil seeds were attempted as intercrops for cashew. Groundnut performed better as an intercrop in cashew in terms of total returns (Rs. 16,188/- per hectare) whereas, the highest cost benefit ratio for black gram (1:2.1) revealed black gram as a suitable intercrop for cashew (Table 9). Black gram led to the highest C: B ratio of 1:2.1 followed by groundnut (1:1.19). However, groundnut resulted in maximum net profit of Rs.16, 187/ha (Table 10). Further, medicinal plants are also found to be suitable intercrops for cashew. Intercropping of *Aloe vera* with cashew recorded higher BCR value of 4.1. *Ocimum sanctum* intercropped in cashew showed sustained performance for four years and *Aloe vera* + cashew for three consecutive years. Hence, *Ocimum* and *Aloe vera* could be promoted as profitable intercrops in cashew.

Orissa

Vegetable crops such as brinjal, cowpea, chilli, bhindi, pumpkin, colocasia were evaluated for their economic suitability as intercrops with different doses of fertilizer. The yield and total net returns per hectare from inter-crops as well as main crop after 4 years revealed that maximum return was received from colocasia (Rs 66,216/-) followed by bhindi (Rs. 58,155/-), brinjal (Rs. 58,035/-), cowpea (Rs 57,635/-), chilli (Rs. 56,815/-), pumpkin (Rs 52,493/-) and control (Rs 40,075/-) (Table 12).

West Bengal

In the eastern humid region, intercrops such as bottle gourd, *Amaranthus*, pumpkin, cucumber and bitter gourd were evaluated at Jhargram. Maximum yield was obtained in cucumber (10.607 Q/ha) followed by bottle gourd (9.615 Q/ha) and amaranths (5.160 Q/ha). The yield of cashew was only 6.00 Q/ha without an intercrop while it was 9.87Q/ha with amaranthus. . The benefit cost ratio (2.44) confirmed that cashew + bottle gourd was the most profitable practice followed by cashew + amaranths (benefit cost ratio of 1: 1.93) and cashew + cucumber (benefit cost ratio of 1: 1.81). Intercrops such as coriander, dill and fenugreek were grown in open canopy area under 5m x 4m spacing. Maximum yield was obtained from fenugreek (14.77 q/ha) followed by coriander (6.74 q/ha). Significant difference was noticed in the yield of cashew between cashew grown alone and cashew grown with intercrops. The yield of cashew was 1.28 q/ha without an intercrop, while it was more than 2 q/ha with intercrops. The cost benefit ratio (0.41) confirmed that cashew + fenugreek was the most profitable practice followed by cashew + dill (benefit Cost ratio: 1: 0.14). When eucalyptus (*E. teretecornia*) was grown as intercrop in cashew, cashew yield was reduced from 200 g per tree for cashew grown alone to 50 g per tree for cashew grown with eucalyptus. The percentage of TMB infestation on cashew was greater (78.8 per cent) when *Eucalyptus* was intercropped with cashew than sole crop of cashew (20 per cent) (Ghose, 1993).

Madhya Pradesh

Under Bastar plateau zone of Madhya Pradesh, intercrops like cowpeas, bush type French bean, cluster beans, ricebeans, urd beans, moong beans, soya beans and ground nuts grown in 3 year old cashew orchard, recorded higher net returns than sole crop of cashew (Gupta, 1999).

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NUTRIENT MANAGEMENT IN CASHEW

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Cashew is grown on a wide range of soils, from the sandy seacoast to laterite hill slopes, pure sandy soils to sandy loam, laterite soil, deep loam and red latosols, but several of these soils have low effective cation exchange capacities and low exchangeable base status. It is also grown on black soils in Tamil Nadu and Andhra Pradesh to a limited extent. Majority of the cashew growing soils in India are lateritic, red and coastal sands which are acidic in nature and poor in soil fertility. Limited or no use of fertilizers and organic manures leading to multiple nutrient deficiencies is one of the major causes of low productivity of cashew in India. The deficiencies of nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), zinc (Zn), boron (B) and molybdenum (Mo) are on the rise in cashew growing soils. It has been estimated that for every one kg of cashewnut produced the plant depletes the soil by 64.1 g N, 2.05 g P, 24.7 g K, 4.19 g calcium (Ca), 1.57 g sulphur (S), 525.7 mg iron (Fe), 63.6 mg manganese (Mn), 87.8 mg Zn and 26.5 mg copper (Cu) nutrients (Beena *et al.,* 1995). Cashew requires regular fertiliser application to ensure early and high yields in new / young plantations, and regular high yields from mature plantations.

Manures and fertilizers are the important inputs which account for 20-30 per cent of the total cost of production, moreover, the fertilizer utilization efficiency is low due to various losses and soil fixation. The availability of soil nutrients to cashew plants depends on several factors. Low levels of available nutrients in the soil may be due to low amounts in the parent material from which the soil is derived, fixation and immobilisation of nutrients, or leaching losses of nutrients under high rainfall conditions. Nutrient imbalances in the soil may also cause limited availability of nutrients. Low nutrient levels may also result from continuous cultivation because of removal of nutrients by cashew plants without subsequent replenishment, leading to nutrient mining in the soil. Due to its extensive root system, cashew can draw its nutrients from large volumes of soil, and as a result it can perform reasonably well on poor soils where other crops fail to do so.

Nutrient dose and response

The major nutrient requirement of cashew plant demands more liberal application of N followed by K, while P is needed in comparatively lesser quantity. Nitrogen has more influence on tree growth, production and quality of cashew than any other nutrient. Nitrogen and P were most important nutrients during the pre-bearing stage, but at the bearing stage, K together with N is also important. The response of cashew to applied N is tremendous and the same is observed universally. Increase in cashew yield due to N application was reported by several workers. Urea is the most commonly used nitrogenous fertilizer in India. However, in Nigeria urea and sulphate of ammonia are generally used. Falade (1984) reported that sulphate of ammonia was superior to urea particularly when medium or high doses of N were applied to cashew.

Phosphorus is the second most limiting nutrient after N in the nutrition of cashew. Phosphorus plays an indispensable role as a universal fuel for all biochemical work in living

cell and in particular root development. Phosphorus deficiency is common in cashew growing acid soils in which the mineral fraction is dominated by kaolinite and sesquioxides. Conflicting reports are observed regarding the response of cashew to P fertiliser. Phosphate fixation of water soluble P is greater in cashew growing acidic soils dominated by kaolinitic type of clay mineral but allows the use of rock phosphate as a good source of P to cashew crop. Of phosphatic fertilizers for use on acid soils in India, the slow-release and more efficient ground Mussoorie (rock) phosphate is popular.

Potassium is the second largest nutrient next to N required by cashew. Potassium is necessary for several basic physiological functions like the formation of sugars and starch, synthesis of proteins, normal cell division and growth, and neutralization of organic acids. It helps reduce the influence of adverse weather conditions like drought, cold, and flooding. Significant positive effects of K on growth, nut weight and yield of cashew were reported by several researchers. Of different sources of K fertilizers, Muriate of potash (potassium chloride) is most commonly used fertilizer in cashew. The recommended dose of K varies from 125 to 750 g/tree/annum as basal depends upon the nature of soil, spacing and age of the cashew plant.

The recommended dose of fertilizers for cashew for major producing states is given in Table 1. Based on the initial fertility status of soil, nutrient dose may vary from location to location. About 10 to 15 kg farmyard manure (FYM)/plant/year is recommended in addition to primary nutrients (N, P and K). The recommended dose of fertilizers varies with the age of plants, plant density and fertility of the soil. Studies conducted at ICAR-Directorate of Cashew Research (DCR), Puttur indicated that application of 500 g N and 125 g each of P and K and 10 kg poultry manure per tree per year under normal density planting system (10 m x 5 m; 200 plants/ha) and 250 g N and 50 g each of P and K and 10 kg poultry manure per tree per year under high density planting system (4 m x 4 m; 625 plants/ha) is found superior in terms of higher nut yield for rainfed cashew in Karnataka. In high density planting system of cashew, the fertilizer recommended is reasonable up to 80-100 per cent canopy coverage which is normally achieved during the initial 6-8 years after planting. After certain stage of the crop, reduction in recommended doses of fertilizers per plant may be necessary due to the nutrient build up in soil due to the deposit of cashew biomass fall out. It has been estimated that by systematically recycling all the waste biomass produced by cashew, it is possible to get back 20.7 kg N, 10.5 kg P_2O_5 and 30.8 kg K_2O /ha/year (Yadukumar *et al.,* 2003).

Table 1. Recommended dose of Fertilizers to Cashew

State	Nutrient dose for mature cashew plantations (from 5th year onwards) (g/tree/year)		
	N	P_2O_5	K_2O
Kerala	500 750	125 325	125 750
Karnataka	500 500	250 125	250 125
Tamil Nadu	500	200	300
Andhra Pradesh	500 1000	125 125	125 125
Maharashtra	1000	250	250
Odisha	500	250	250
West Bengal	1000	250	250

Source: Compiled from ICAR-DCR, Puttur and AICRP-Cashew Centres

Integrated nutrient management practices involving chemical fertilizers, organic manures / green manuring and biofertilizers which constitute an efficient nutrient management strategy in cashew are essential to maintain / enhance the soil quality and for sustainable production. Green leaf manuring with *glyricidia* and sesbania in cashew resulted in higher nut yield and improvement in soil nutrient content. The *glyricidia* contributed 186 kg N, 23.6 kg P_2O_5 and 126.2 kg K_2O/ha and sesbania contributed 141 kg N, 17.9 kg P_2O_5 and 162.3 kg K_2O/ha (Yadukumar *et al.,* 2008). The use of biofertilizers is of relatively recent origin. Application of *Azospirillum*, *Azotobacter* and Vesicular Arbuscular Mycorrhizae increased the germination percentage of nuts and plant growth, and reduced the incidence of fungal diseases in the nursery (Kumar *et al.* 1998).

The amounts of nutrient elements recycled in canopy fallout may partially meet the nutrient requirements of cashew. About 15.5–37.7% of tree total requirements of macronutrients are recycled from canopy biomass fallout of leaves, cashew apples and flowers from six year old cashew trees in Australia (Richards, 1993). Studies conducted at ICAR-DCR, Puttur on nutrient budgeting and nutrient balance in a six year old cashew plantation of 'Bhaskara' variety under high density planting system (625 trees/ha) showed a negative N, P and K balance of 113, 38 and 92 kg/ha in control plot where no fertilizer was applied. A strong positive N, P and K balance ranged from 128 to 253, 18 to 54 and 34 to 128 kg/ha were recorded in plots with 2/3rd and full dose of recommended fertilizers (750 g N and 150 g each of P_2O_5 and K_2O per tree/year).

Organic production of cashew offers immense potential. Cashew plantations have vast potential of organic biomass available for recycling. The availability of cashew leaf litter from different age group plantations (10 to 40 years) ranged from 1.38 to 5.20 t/ha. Vermicomposting of cashew leaf litter and apple by using local earthworm *Eudrilus spp.* has been standardized at ICAR-DCR, Puttur. About 5.5 tonnes of available cashew biomass waste per ha can be converted into 3.5 tonnes of compost or vermicompost and helps in meeting nutrient requirement to cashew by 50 per cent.

The application of fertilizers through the irrigation water (fertigation) has the advantages of increasing the efficiency of the fertilizers and reducing the costs of labour and machinery for its application. Fertigation allows the application of nutrients with greater frequency, without increasing the cost of the application, minimizing losses by volatilization and leaching and optimizing nutrient absorption by the roots. The nutrients most frequently applied in fertigation are those with greater mobility in the soil. Water soluble fertilizers like urea, diammonium phosphate and muriate of potash are used for fertigation through drip lines from December to March and application of 2 kg castor cake to soil during August. Fertigation is done once in a week from December to March. With fertigation quantity of nutrients (through fertilizers and organic manures) to be applied can be reduced to half of the quantity of recommended nutrients. An increase of 100 per cent and 226 per cent in yield was observed in the treatment received half of recommended dose of NPK in inorganic form (Recommended dose: 500 g N, 125 g each of P_2O_5 and K_2O/tree/year) of nutrients through fertigation and balance half applied in organic form through castor cake as compared to the above dose through soil and separately irrigated and absolute control (without manure and irrigation) respectively indicating better nutrient use efficiency.

Time and method of fertilizer application

The key to enhance fertilizer use efficiency is to synchronize the time of fertilizer application with the growth need of the crop and period of high root activity. Highest root activity and peak absorption of N, P and K occurred during the flushing and early flowering phase (September to December) and suggested that the onset of this phase is the most appropriate time for fertilizer application in a cashew orchard. The annual dose of fertilizers to cashew are to be applied in two split doses, the first split dose at the onset of the monsoon period and the second split dose during the post-monsoon period when the soil moisture condition is at its optimum; if only one application is given, it should be in the post-monsoon period when enough moisture is available.

Cashew trees are surface feeders with about 50 per cent of the root activity being confined to the top 15 cm of the soil and about 72 per cent of root activity was found within a 2 m radius from the tree trunk (Wahid *et al.* 1993). This suggested that application of fertilizers within a radius of 2 m from the main stem results in efficient utilization of the applied nutrients. During the 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} year of planting $1/5^{th}$, $2/5^{th}$, $3/5^{th}$, $4/5^{th}$ and 5^{th} year onwards full quantity is to be applied. George *et al.* (1984) standardized the methods of fertilizer application to cashew and reported that application of N, P and K fertilizers in two circular trenches (1.5 and 3.0 m from the trunk) for sandy soils, a single trench method (25 cm wide and 15 cm deep circular trench at 3 m from the trunk) for sloping ground, and the band method (in a circular band 1.5-3.0 m from the trunk + soil incorporation) for flat ground are best suited. The root activity of cashew in relation to phenological phases studied by Beena *et al.* (1995) employing ^{32}P soil injection technique reported that 'flushing and early flowering phase (September to December)' is the most appropriate time for fertilizer application in cashew orchard. The annual dose of fertilizers to cashew are to be applied in two split doses, the first split dose at the onset of the pre-monsoon period and the second split dose during the post-monsoon period when the soil moisture condition is at its optimum; if only one application is given, it should be in the post-monsoon period when enough moisture is available.

Foliar feeding

The essential micronutrients *viz.,* Fe, Mn, Zn, Cu, B, Mo, chlorine (Cl) and nickel (Ni) are needed by plants in very small quantities and mainly function as components of a series of enzymes. Deficiency or toxicity of these elements in soil adversely affects the growth and development of cashew plants. Among micronutrients, deficiencies of Zn, B and Mo are more common in cashew growing acid soils. Iron and Al toxicity is a distinct problem. Micronutrient deficiencies in soil not only limit the cashew production but it also has negative effects on human health. Foliar feeding is often the most effective and economical way to correct micronutrient deficiencies in horticultural crops. Foliar application of nutrients normally reduces the loss through adsorption, leaching and other processes associated with soil application. Deficiencies of micronutrients can be corrected by foliar sprays of ferrous sulphate (0.5-1%), manganese sulphate (0.5-1%), zinc sulphate (0.5%), copper sulphate (0.1%), solubor (0.1%) and Mo (0.1%) salts to cashew at the emergence of the flush, panicle initiation and fruit set stages.

It is crucial that level of micronutrients in soil and plant should be optimum for growth and development since the micronutrients' need is site specific. The deficiency and toxicity limits of micronutrients in plant are rather narrow. This calls for location specific management of

micronutrients in cashew so that these do not become toxic to plant. To minimize wide spread deficiency of micronutrients, it would be the best option to incorporate them into macronutrient fertilizer sources like urea, diammonium phosphate / rock phosphate, muriate of potash etc. which facilitates to apply small quantity of micronutrient fertilizers over a large field area in a uniform manner.

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IRRIGATION AND FERTIGATION IN CASHEW

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Although the cashew may grow and produce in regions with mean annual rainfall distribution ranged from low rainfall (300-600 mm in Gujarat) to high rainfall (2700 to 3000 mm in West coast and NEH region) with a drought of 4 to 5 months, irrigation allows maximum productivity. In cashew flushing, flowering and fruit development stages are critical phases that decide the nut yield. Any form of stress, (biotic or abiotic) during these phases can decrease the yield substantially. Due to the non-uniform distribution of rainfall, cashew experiences severe moisture stress from December to May, which adversely affects its flowering and fruit set causing flower drying and immature nut drop. Water availability strongly influences flowering and fruit set and can affect fruit drop, fruit size, yield, nut quality characteristics and canopy development. Studies in India have shown that nut yield can be enhanced by providing protective irrigation with 200 L of water per tree once in 15 days from January to March during the summer season. Research results in Brazil and other countries have shown that irrigation could increase productivity by up to 300 per cent depending on the region. Drip irrigation is the most efficient irrigation system with savings of between 40 and 60 per cent over other irrigation systems. In drip irrigation only a portion of the soil area around each plant is irrigated. Water movement into and through the soil from point source such as drip irrigation increases the capacity of soil water movement phenomenon affecting the dimension of wetted volume, movement of fertilizer in the soil solution / irrigation water.

Water requirement, time and method of irrigation

Cashew tree is considered drought resistant to some extent and is generally grown as an unirrigated crop, but the yield can be doubled, if irrigated. Low productivity is the main concern in cashew cultivation in India. Of several factors associated for such low yields, the low moisture availability during the fruiting season which normally coincides with the onset of dry season in the cashew growing areas is one of the factors. Field experiments conducted at ICAR-DCR on fertigation in cashew indicated that under normal density planting system (7 m x 7 m), the effective canopy coverage per tree is 12.56 m^2. The quantity of irrigation water calculated based on the effective canopy area was 12.56 L/tree/day from December to January (Daily open pan water evaporation is 5 mm) and 20 L/tree/day from February to March (Daily open pan water evaporation is 6.5 mm) to meet 20% of the cumulative pan evaporation (CPE). Similarly, for 40% CPE and 60% CPE, the irrigation rate was 24 L/tree/day and 38 L/tree/day from December to January and 36 L/tree/day and 58 L/tree/day from February to March, respectively. In order to meet 20% CPE, four drippers of 2 L/h discharge rate can be fitted at two equidistant points 1 m away from the base of the tree. Similarly, to meet 40% and 60 % CPE, four drippers and six drippers of 4 L/h discharge rate can be fixed. Drip irrigation can be given for 1 h 30 min during December and January and 2 h in February and March.

Case study for estimating water requirement of cashew tree to meet 20% CPE

Age of the tree : 5 years
Canopy spread : 4 m, Canopy spread = canopy diameter = mean of EW and NS length
Canopy area = πr^2 where r = radius of the canopy.

If the radius is 2 m, the total area covered by individual tree canopy is 3.14(π) x 2^2 = 12.56 m^2 (Ground coverage by canopy)

Daily CPE = 5 mm, 20% of CPE = 1 mm, Therefore, quantity of water to be given to meet 1 mm of water in 12.56 m^2 area = 12.56 x 1/1000=0.01256 cubic M, 1cubic M =1000 L. Therefore, 0.01256 cubic M =12.56 L/tree/day. Like this quantity of water required to be given is calculated depending upon canopy coverage and daily water evaporation.

Supplementary irrigation with limited source of water (protective irrigation)

- Protective irrigation during peak summer season reduces fruit drop and thereby increase in nut yield.
- Black polyethylene mulch with irrigation at a rate of 60 L/tree once in fortnight resulted in maximum fruit retention of 66.15 per cent which was significantly superior to other treatments such as irrigation alone, polyethylene mulch alone and without any irrigation. Irrigating @ 200 L/tree once in 15 days starting from November to March resulted in two fold increase in yield over control (No irrigation). In cases of limited availability of water, irrigation is to be given from January to March (5 irrigations) once in 15 days @ 200 L/tree to obtain 50 to 100 per cent higher yield.
- In West coast, the rainy season extends upto November and December (North East monsoon) resulting soil moisture content going up to 10 to 15 per cent by weight. During January to March, the soil moisture is as low as 8.82 to 9.30 per cent.
- The field capacity and permanent wilting point in this region for sandy loam type of soil is usually 20 and 7 per cent respectively.
- Soil moisture depletes after August. On the other hand, atmosphere and soil temperature increases gradually. These triggers flowering in cashew in December in case of early varieties and January and February in case of mid and late season varieties.
- Soon after the flowering, at the time of nut set and nut development in January to March the crop undergoes moisture stress.
- It is during this period the crop requires protective irrigation for doubling the yield.
- Drip irrigation system in cashew orchards where water source is available is also recommended.

Drip Irrigation

- If good water source is available and drip irrigation facilities are provided, irrigating 80 L/tree once in four days or irrigating daily at a rate of 20 L/tree through drippers placed at four points at equidistance 1m away from the base of the plant can be followed.
- Irrigation to be started from second fortnight of December to end of March (30 irrigations, 2400 L/tree/year).
- In four to eight years after planting, the increase in cumulative yield due to irrigation is 165 per cent of that of control plot receiving no irrigation.
- Irrigation at 20 L water/day from December to March has wetted 7.75% of the given ground area and 56% of the effective root zone.
- Irrigation increased the yield through increased tree canopy area, flowering laterals/tree, bisexual flower production, nut retention, number of nuts produced per tree and weight of nuts.

Fertigation for efficient water and nutrient management

(a) Normal density planting system (200 trees/ha)

- Fertilizer mixture used for application of 50 per cent recommended doses of fertilizers (500 g N and 125 g each of P_2O_5 and K_2O per tree/year).
- The fertilizers like Urea, DAP and MOP (20 kg Urea, 6 kg DAP and 4 kg MOP) are dissolved in water by continuous stirring and applied to 200 plants (1 ha) through drip irrigation system per month through venturi. Like this 5 applications are given for one season.
- Each split dose is given once in each month starting from October to December and from January onwards the monthly-allotted dosage is further split into four doses and given once in a week up to February through drip irrigation system.
- Highest profit of about Rs. 27,300/- per ha (with a B:C Ratio of 3.71) can be achieved in plot receiving half of recommended dose of nutrients through fertigation and balance half applied in the form of castor cake to soil, while the profit is about Rs. 9000/- when the NPK dose was given to soil.

(b) High density planting system (625 trees/ha)

- Fertilizer mixture used for application of 50 per cent of lower dose of fertilizers i.e. 250 g N and 62.5g each of P_2O_5 and K_2O /tree/year.
- The fertilizers like Urea, DAP and MOP (31.25 kg Urea, 9.375 kg DAP and 6.25 kg MOP) are dissolved in water by continuous stirring and applied to 625 plants accommodated in an area of 1 ha through drip irrigation system per month. Like this 5 doses will be given for one season.

- Each split dose is given once in each month starting from October to December and from January onwards the monthly-allotted dosage is further split into four doses and given once in a week up to February through drip irrigation system.

- The Organic manure-castor cake at the rate of 2 kg/tree is to be applied in August when sufficient moisture is available in pits dug out in dripping point located at 1 m distance from base of the tree. The rate of drip irrigation is to be given to meet 20% of evaporative demand. This is equal to 7 L for 1 hour 45 minutes/day from December to January and 9L for 2 hours 15 minutes /day from February to March. Totally two drippers of 2 L/hr capacity should be installed at the base of the tree located at 1 m equidistance from base of the tree.

- Highest profit of about Rs. 48,400/ha with B: C ratio of 3.39 can be achieved in plot receiving half of lower dose of nutrients through fertigation and balance half applied in the form of castor cake. While profit of Rs. 40,000 can be achieved when same dose of NPK is applied to soil.

HIGH DENSITY PLANTING AND CANOPY MANAGEMENT IN CASHEW

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High density planting of late became a very popular technology in most of the crops to harness the initial benefits of closer planting in the orchards. In tree crops when go for wider spaced planting lot of space will get wasted, at least for a initial few years. Many occasions, the mixed or inter cropping in the vacant spaces with annual crops species is suggested to cover such spaces and exploit maximum out of the given piece of land. But in crops like cashew as the production is as such very low and requires to meet the demand in short span of time, high density is proved to be an successful venture in the initial few years to achieve higher productivity.

Requirements of high density

For a successful high density orchard an early bearing precocious variety is most essential requirement. The precocious variety's will help to take early benefits of closer spacing. Secondly, the plant should be slow growing, so as to avoid pruning and throwing away the vegetative growth. It was suggested in other crops either (i) a variety should be dwarf and compact, (ii) should be grafted on a dwarfing root stocks, (iii) go for use of growth reducing chemicals or growth retardants or (iv) adopt regular pruning of unwanted growth in order to control the size of the plant within the allotted spaces. As in cashew dwarf types or dwarfing root stocks are yet to be identified or exploited and Paclobutrazol an growth retardant becomes a cost lier affair and also not recommended for want of information on several issues the only option remains is pruning and canopy management.

Studies were conducted on high density planting of cashew at Directorate of Cashew Research, Puttur, Shantigodu since 1996 onward and in coordinating centres in different cashew growing States. The results are quite encouraging. It has been proved that cashew yield can be increased to 4 folds up to 6 years and 2.5 folds up to 12 years if high density planting system of 625 trees/ha.is maintained. The above result was compared with normal density of 156 trees/ha. Details are as follows:

System of planting	Spacing (M)	Density No./ha	4th to 12th year Cum.yield Kg/ha
Normal density	8 x 8	156	2275
High density	4 x 4 upto 11 years and 8 x 5.6 x 5.6 after that	625 upto 11 years and 312 after that	3944

High density planting of cashew is more suitable in less fertile area. Because in area where soil fertility is low growth of the plant is very much slow resulting less ground coverage in the initial years. In such locations if normal density planting with 8m x 8m spacing (156 trees/ha) is done the yield is very low in the initial stages of plant growth.

Economics

It was worked out that the net profit/ha was Rs.77054 in high density planting plot for the first 12 years. Where as in normal density plot (156 trees/plot) the profit was only Rs.26201/ha.

Package for establishing high density cashew orchards

Pits of 100cm x 100cm x 100cm (Lbd) should be opened at 4M distance between two rows as well as in each row between two pits. In slopy area pits should be opened all along the contour line at 4m distance from one row to another row as well as from one pit to another pit within the row. The pits are normally opened with the onset of monsoon so that soil is soft during this period for easier work. The pits should be kept open for a week or so for exposure to sun light to ward off termites, ants and other insects. The pits are then filled with a mixture of top fertile soil, with 8-10 kg organic manure and 200g rock posphate. Cashew grafts of high yielding varieties should be planted in the pits after scooping out 1 spade full of soil in the top centre of the pit. After planting grafts proper staking should be done to avoid breakage in the graft joint due to wind blow. Mulching with dried leaves or green leaves should be done to prevent soil erosion particularly in slopy area during rainy season and also to conserve moisture in summer months. Care must be taken to see that all side shoots coming out below and above graft joint is removed frequently up to 0.45 M from ground level. This is necessary for providing proper shape to the plant with solitary strong stem and for the convenience of cultural operations like weeding, fertlizer and organic manure application, plant protection works and for picking nuts. This also avoids stem borer infection to some extent.

The recommended manurial schedules are as follows. The fertilizers and organic manures in the first year are applied within 50cm radius from the stem of plant @366g urea, 67g muriate of potash and 200g rock phosphate/tree/year. Out of this dose 200g rock phosphate is given at the time of planting graft as explained earlier. The organic manures should also be applied at the time of planting .In the second year fertilizer and organic manure should be applied at 75 cm radius away from the stem of the plant in circular trench dug out (25cm width 15cm depth). The poultry manure @ 2kg/plant should also be applied in the trench and covered with soil. Mulching should be done immediately after the application of manures. Third year onwards full dose of fertilizers and 5kg of poultry manure/ plant should be applied in circular trench dug out 1.5m away from stem of the tree(1100g urea 625g rock phosphate and 200g muriate of potash/plant/year). Manures should be applied soon after cessation of heavy showers (August).

Deblossoming should be done for the first one years to encourage development of proper canopy in case of growth of the plant is not up to satisfaction. Regular shape pruning should be done to achieve umbrella shape canopy with uniform spread .During the first 6 years the crop canopy covers almost 100% of the given ground area. Beyond 6 years because of over lapping of branches thick shade is formed which in turn reduces yield. It is at this stage branches towards the periphery end is cut back by 0.5m radius around to allow 80% of light interception by the crop canopy and remaining 20% to the ground penetrating through gaps in the canopy. Normally pruning is done during August. Soon after this 10% bordeaux paste is applied to the cut ends of the thicker branches. Detopping at 3m height from 5th year onwards is necessary. By 11th year it is necessary to thin out tree population to 50% by removing every alternate tree in each row. Once the canopy has developed pruning of leader shoots (Last years growth) should be done at least once in two years regularly. At

least 60% of the canopy spread should be used for pruning. Length of leader shoot to be pruned should not be less than 8cm and more than 12cm. This will further increase yield by giving out more number of productive lateral shoots which flower in the same year.

Advantages of high density planting is that the weed growth is minimum due to early ground coverage by the crop canopy causing heavy shade over the ground space. This restricts weed growth. Under normal density planting system the trees are at wider spacing leading to maximum exposure of ground area to sun light causing maximum growth of weeds that directly compete with cashew for nutrient and moisture. In high density planting system because of less exposure of ground to sun light the soil temperature during peak summer season is reduced there by reducing soil moisture loss through evaporation. The evaporation from ground surface is also reduced considerably due to heavy deposit of cashew leaves under high density planting system. These leaves when incorporated in soil will be a good source of Nutrients for better plant growth and yield.

Ultra high density planting

Going for much closer spacing with precocious pruning responsive cashew varieties was tried and the results were encouraging. A close spacing of 2.5 M x 2.5 M or 3 M x 3 M which can accommodate 1600 plants or 1111 plants/ha yielded better results and recommendation of this is awaited.

Canopy Management

Cashew like any other wild tree grow very fast with its spreading branches erratically if they are not managed properly. As cashew is highly sun loving plant it requires lot of pruning and thinning of branches to maintain the shape of canopy. If proper pruning and training is done from the beginning the subsequent removal of heavy vegetative growth can be avoided.

Training

Training is a method to direct the plant growth to a desired form. Some of the parts of a plant are pruned with a view to giving the plant a frame work. Support may also be provided. Detopping etc. may also be done. Training is combined with pruning.

- Training is judicious removal of any plant part to give proper shape/to provide a good frame work for the future.
- Training is done in the initial years of planting.
- A strong central stem is allowed to grow.
- Branches are spaced properly.
- The trees are skirted (trunk is kept clean) upto a height of 60-75cm to keep the lower branches off the ground. This should be done every year upto 4-5 years by removing the lower branches.

- The trees are also pruned or detopped to a workable height (5-6m from ground) after 4-5 years of planting.
- During 1st and 2nd year of planting, the flower panicles are also removed to encourage vegetative growth.
- Around the trunk soil mounds may be provided to strengthen the tree's anchorage against cyclonic winds/heavy winds.
- The plants should be provided with staking support during 1st, 2nd and 3rd year of planting.
- Training facilitates easy cultural operations, nut collection, monitoring of CSRB etc.

Pruning

Pruning is judicious removal of unwanted plant parts. When annual growth of a plant are specifically removed, the operation is called pruning. In pruning the form of the tree is not at all affected, but its cropping is highly influenced.

The trees are pruned annually in two ways:

- Thinning - A few shoots or branches that are considered undersirable, are removed entirely without leaving any stub.
- Heading back - Removing the terminal portions of all branches leaving their basal portions intact.

Pruning is done to divert a part of the plant energy from one part to another. When a branch is headed back, the buds below the cut sprout and develop into new shoots. Pruning of any kind, according to its severity, changes the nutritive conditions within the tree and consequently limits or encourages fruit bud formation.

- Heading back may be a good practice for plants in which fruit bearing shoots are produced laterally from basal portions of the previous year's growth.
- Heading back may be disastrous for plants that produce fruit bearing shoots from the terminal portions of the shoots.
- The minimum amount of pruning which is common to all, is the removal of broken or diseased branches, dead wood, dried twigs / branches, criss-cross branches, water shoots / sprouts, crown suckers etc.
- Annual pruning may be very light in the beginning and it may be heavy after some years. Otherwise, the trees may lack vegetative vigour and make very little growth.
- Heavy pruning may extend the juvenility of plants.

a) Water shoots/water sprouts

They are Extraordinarily vigorous vegetative shoots which grow from high points on the main branches in an upright direction at the expense of the parent branches from which they arise. They consume lot of food material. They are much thicker than the normal shoots. They bear much larger and coarser leaves. They grow in such rapidity in one season that they out grow and impoverish the rest of the neighbouring drooping branches of the tree. They are unproductive. If water shoots are not properly removed, they soon close the centre of the tree and obstruct light. They should be removed as soon as they appear.

b) Making pruning cuts

- While removing an entire branch (thinning) the cut should be made close to and even with the outline of the mother limb. No stub portion of the branch should be left on the limb. A clean wound heals smoother and more rapidly.

- While heading back a shoot, the pruning cuts are made between nodes. This results in continued branching and shoot growth. Branches with a diameter of 2cm or less could easily be removed with a secateur, without splitting the shoot/tearing away the bark. Thicker branches can be removed with a garden saw / sickle.

c) Treating of cut wounds

- To avoid fungal infection, to prevent drying of the tissues, and to promote healing of wound (to facilitate the development of callus tissue), the cut surfaces should be treated with Bordeaux paste (10%).

- The wounds under 2.0-2.5cm in diameter need not be treated. The smaller wounds on the tree top may be sprayed with Bordeaux mixture (1%). The wounds greater than 5cm in diameter should be treated with Bordeaux paste (10%).

Training and Pruning in Cashew

Pruning as an horticultural practice was not being followed in tropical evergreen fruit crops for the improvement of yield as the need for such improvement was not felt. Of late, pruning is gaining importance in fruit trees, such as mango, guava, fig. etc. as an orchard management technique to improve the sanitation, easy cultural operations and yield.

In cashew the need for pruning as an orchard management practice is imperative since the nut yield in the existing orchards is very low and demand on the other hand is increasing many folds. The studies conducted at ARS, Ullal, have indicated that removal of dead wood and criss-cross branches from old and unthrifty trees markedly increased the yield. Average yield increased from 1.44 kg/tree before pruning to 2.36, 4.39, 5.53 and 6.08 kg/tree during the first, second, third and the fourth years of pruning respectively. Therefore, there is a need for pruning cashew trees once in 2-3 years.

Studies conducted at NRCC Shanthigodu on the effect of time and severity of pruning in cashew trees of 12-13 years old indicated that the leader shoot pruning done in July and August will help in doubling the nut yield. This has resulted in the production of higher number of lateral shoots and higher number of bisexual flowers per panicle.

a) Training of young cashew plants

Training in cashew should be limited to the removal of criss-cross branches, branches with narrow crotches to facilitate proper light penetration and development of strong scaffold branches to give the young tree a uniform crown around the stem. The lower branches on the main stem are to be gradually removed in the first 2-4 years to a height of 60-75 cm from the ground level.

b) Pruning of old cashew trees

As the age of the tree advances the productivity goes down due to the fall in the vigour of the plant. At that stage severe pruning helps in the production of more vegetative growth which results in higher yields.

Leader shoot pruning

In a large tree about 60 per cent of the leader shoots are to be pruned in May-June by heading back to 2/3rd of the length. Along with this the water sprouts, criss-cross branches, dead and dried shoots are to be pruned by thinning. Pruning of leader shoots should not be carried out every year as this may lead to over exhaustion of the tree which is already weak. Hence, pruning may be taken up once in 3 years.

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MANAGEMENT OF TEA MOSQUITO BUG IN CASHEW

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Preamble

Tea Mosquito Bug (TMB) is one of the major pests of cashew. Three species of TMB, *viz., Helopeltis antonii* Signoret, *Helopeltis bradyi* Waterhouse and *Helopeltis theivora* Waterhouse are found in India. Among them, *H. antonii* is the dominant species. TMB belong to family: miridae, sub family: bryocorinae and tribe: monaloniini. The genus *Helopeltis* was upgraded mainly to differentiate it from the closely resembling genus *Pachypeltis.* The early records these pests especially in tea commonly called as 'tea bug' and 'tea mosquito' and the damage was reported as 'tea blight', 'mosquito blight' and 'spot blight'. The same common terminologies are in usage even now. Both nymphs and adults feed by sucking the plant parts, injecting poly-phenoloxydase(toxins) from their salivary glands. Typical feeding damage by *Helopeltis* spp. Appears as a discoloured necrotic area or a lesion around the point of entry of the mouth parts inside the plant tissue. The infestation of inflorescence results in "blossom blight". Each insect can damage 3-4 shoots or panicles leading to heavy loss in yield. Under outbreak situations, a damage of 25-30 per cent may be expected.

Biology

The adult bugs are slender; elongate, 6 to 8 mm long, reddish brown in colour with a black head, red thorax and black and white abdomen. Colour variation among the adults has been reported. A pin like, knobbed scutellar process occurs dorsally in both the nymphs and adults except in the first instar nymphs. The pre-oviposition and oviposition periods ranged from 3 to 5 days and 5 to 10 days, respectively. More than 75 per cent of the eggs are deposited during the first half of oviposition period. The presence of sex pheromone in females of TMB has been demonstrated. The eggs are inserted into tender shoots, stalk of inflorescence and on the leaf midrib and petioles, either singly or in groups of 2 to 6. The presence of a pair of minute silvery hair like unequal chorionic processes indicates the presence of an egg. The five nymphal instars are completed in 8 to 13 days. Adults live for about 5 to 18 days and the total life cycle is 20 days. A mass culture technique for TMB has been amari nizin using cashew shoot as a host material.

Alternate hosts

The nymphs and adults of TMB feed on a wide variety of plants such as eucalyptus, mahogany, neem, cocoa, cinchona, guava, drumstick, black pepper, Singapore cherry, cotton, mehendi and allspice. During off season, the activity is mainly confined to these hosts and the pest migrates to cashew during flushing, flowering and fruiting period of cashew. Cashew is the most preferred host for TMB during the cropping season.

Distribution

The pest is distributed in most of the cashew growing regions of Kerala, Karnataka, Goa, Maharashtra, Tamil Nadu, Andhra Pradesh, Gujarat, Chhattisgarh and Orissa. Neem is the primary host of *H.antonii* especially in Tamil Nadu and southern parts of Karnataka and Andhra Pradesh. The pest spreads to cashew from neem in these areas, whereas in Maharashtra, Gujarat and Chhattisgarh it is confined mainly to cashew. Apart from *H.antonii H. theivora*, *H.bradyi* and *Pachypeltis mesarum* Kirkaldy are also causing similar damage to cashew in certain areas.

Nature of damage

Typical feeding damage by *Helopelti*s spp. Appears as a discoloured necrotic lesion around the point of entry of the labial stylets into the plant tissue. The lesion can be elongate or spherical, and becomes darker with age as the tissue around the stylet puncture dies, in response to the enzymatic action of the insects' salivary secretions. Nymphs and adults of *H. antonii* initially tap the plant surface with labial tip followed by immediate insertion of stylet intracellularly with a minimum depth of 0.3mm. Water soaked lesion appeared within a minute after insertion of stylet indicating rapid diffusion of salivary secretion. Feeding on a single site lasted with a maximum of 17 min and evacuated the contents of plant cells leaving initially the cell walls intact and uncollapsed. Subsequently, the melanization and necrosis of feeding lesions appear. In the salivary gland of *H. antonii*, hydrolytic enzymes (protease and lipase), oxido-reductase enzymes (catechol oxidase, catalase and peroxidase) and free amino acids were detected. The salivary enzymes caused phyto-toxaemia on various host plants as well as detoxification of defensive chemicals especially in the neem. The role of free amino acids existing in salivary secretion was to protect the salivary enzymes from denaturing by defensive chemicals of host plants.

Both nymphs and adults suck the sap from tender leaves, shoots, panicles and immature nuts and apples. The injury due to insertion of stylets by the insect induces exudation of resinous gummy substance. TMB also releases certain toxic secretion into cashew. All these activities of the insect lead to the typical formation of necrotic lesion symptoms around the point of stylet insertion by the bug. The lesions on shoots coalesce and ultimately result in drying of shoots/ shoot blight.

The infestation of inflorescence or panicles results in blossom blight. In certain endemic areas, most of the flushes dry up and the tree presents a scorched appearance. The immature nuts infested by TMB shrivel and dry up, while older nuts and apples develop a scabby appearance. Each insect can damage 3-4 shoots or panicles during its life cycle thereby, leading to heavy loss in nut yield.

Seasonal abundance

Helopeltis spp. Exhibit a continuous cycle of generations throughout the year likeother Tropical mirids. On cashew, the build up of the *H. antonii* commences during October/November amari nizing with the emergence of new flushes, after the cessation of the monsoon. The population reaches a peak during January, when the trees are in full bloom. The pest in n the field till May and is absent during the monsoon (June-September) especially in older plantations. However, the population

exists in a negligible number during monsoon period. But in young plantations, the pest is noticed continuously with a higher intensity during February and March. Negative relationship between rainfall and incidence of *H. antonii* is reported , whereas, in guava no such relationship was observed between incidence of *H. antonii* and weather factors . However, in Tamil Nadu, the outbreak of *H. antonii* depends on its severity on neem. Once, severe outbreak occurs on neem, the population rapidly spreads to cashew, guava, drumstick and ber, wherein damage on cashew will be severe on panicles and tender apple and nuts. Similar situation also prevails in west coast condition in a different form. The population build up is regular in young plantations in which all the plants will have infestation. Subsequently, it will be patchy as the age of plantation progress and in the plantations of the age group of 10 years and above, low level of population prevails. But, whenever, old plantations are situated near to young plantations, under severe outbreak condition, the population from young plantation rapidly spreads to older plantations, resulting in severe outbreak. The life table studies carried out with *H. antonii* on cashew, neem and guava revealed that rapid build up of population is more likely on neem and cashew than on guava. The demographic studies of *H. antonii* on cocoa, neem and henna suggested that the pest can multiply more rapidly on cocoa and neem than on henna and also sustained under unfavourable conditions on both the host plants.

Fluctuations in the weather parameters were found to influence the build up of tea mosquito bug under field conditions. Minimum temperature and sunshine hours were highly correlated with increased *H. antonii* populations. The maximum temperature and afternoon humidity also had significant effect on *H. antonii* population. The largest populations were observed in December and January. The *H. bradyi* population showed significant correlation ($p < 0.01$) with minimum temperature. The observations of minimum temperature and sunshine hours can be an indicative to predict the behavior of the field trend of *Helopeltis* spp. Populations and planning control measures.

Incidence of disease

The fungal pathogens, *viz*., *Gloeosporium mangiferae* and *Phomopsis anacardii* have been reported to cause blossom blight in association with TMB. The feeding injury by the bug is one of pre-disposing factors for the infection and expression of die-back disease caused by *Colletotrichum gloeosporoides* and *Botryodiplodia theobromae*. When the dried shoot is split open, discolouration may be seen in softwood region indicating the manifestation of the fungal disease. A loss of 25 to 50 per cent nut in nut in yield has been reported from Karnataka, Maharashtra, Goa, Kerala and West Bengal due to combined effect of TMB and disease incidence.

Natural enemies

A total of four endo- parasitoids have been recorded parasitizing eggs of TMB in west coast regions of the country. They are *Erythmelus helopeltidis* Gahan. (Mymaridae) *Telenomus* sp. (Laricis group) (Scelionidae) and *Chaetostricha* sp. (Trichogrammatidae) and *Gonatocerus* sp. Nr. *Bialbifuniculatus* Subba Rao. In the east coast , *Ufens* sp. Is the only egg endo- parasitoid observed on TMB. However, the attempts to multiply these endo-

parasitoids under laboratory conditions was not successful, as these require live TMB eggs for the development.

Several species of spiders, *Hyllus* sp., *Oxyopes sehireta*, *Phidippus patch* and *Matidia* sp. Have been observed predating on TMB . Several species of reduviid bugs (*Sycanus collaris* (Fab), *Sphedanolestes signatus* Dist. And *Endochus inornatus* Stal., *Irantha armipes* Stal. And *Occamus typicus* Dist. Have also been recorded as predators. Ants of the species *Crematogaster wroughtonii* Forel (Formicidae) and *Oecophylla smaragadina* Fabricius predate on nymphs of the pest. *Aspergillus flavus* and *A.tamarii* are reported as entomopathogens on TMB.

Varietal resistance

Though all the germplasm accessions and varieties are potentially susceptible to this pest, “Bhaskara”, a variety developed at ICAR-Directorate of Cashew Research, Puttur escapes TMB damage due to non-overlapping of the cropping period with that of peak pest population. This variety was developed from a tree of seedling origin identified during 1982 from severely of TMB infested location, situated at Forest Department Cashew Plantation, Gaodengrem, Canacona Taluk, South Goa. This variety has mid-season flowering habit which aids in escaping from the attack of TMB under low to moderate outbreak situation. In the case of pest damage on first batch of panicles, the trees flower again enhancing the possibility good yield during the same season. In the varieties like Ullal-1 and Madakkathara-2 major flowering /fruiting is delayed *i.e.*, in the month of February onwards. As these months are not favourable for the multiplication and establishment of TMB, these varieties suffer less due TMB.

Chemical control

Proper surveillance for pest damage symptoms during flushing, flowering and fruiting period is essential for the management of this pest. Whenever the incidence of pest is noticed on 5-10 per cent of the flushes, the first round of pesticidal spray should be given. The second round of spray should be invariably completed within 3-4 weeks time if the TMB population still persists. If panicle damage is severe (beyond 50%) because of delayed insecticidal application, further sprays will not result in improved yields. Hence, it is absolutely necessary to keep a constant vigil on the build up of the pest especially during first month of flushing and to initiate timely insecticidal control. However, a two spray schedule(need based) is being presently recommended instead of routine/earlier recommended three spray schedule. The third spray needs to be taken up only based on necessity i.e., in case pest population persists even after the second spray.

The present recommendation for chemical management of tea mosquito bug is as follows:

First spray	:	Monocrotophos(0.05%) or Profenophos (0.005%) - at flushing stage
Second spray	:	λ-cyhalothrin (0.003%) or triozophos (0.05%) – at flowering stage.
Third spray(if pest persists)	:	λ-cyhalothrin (0.003%) – at fruit set stage

Though cashew is an insect pollinated crop, use of λ-cyhalothrin (0.003%) during the flowering stage did not affect the fruit set. Among the different insecticides, λ-cyhalothrin (0.003%) has higher benefit cost ratio (4.5).

Whenever die- back disease is noticed, the affected shoots and branches below the site of infection should be pruned and destroyed. The cut surface should be protected with Bordeaux paste (10%). Spraying the canopy with Bordeaux mixture (1%) may be followed after this process.

General precautions for insecticidal application:

- Chemical should be mixed properly and filtered before filling the sprayer.
- Spraying should be done in the early hours of the day (7-11 AM) or in the evening (3-6 PM).
- Spraying should be taken up immediately when initial symptoms of TMB damage are noticed first.
- If it rains immediately after spraying, the spraying has to be repeated.
- Entire canopy area should be sprayed with chemical. Approximately, 6-8 litres of solution is required for a tree of 15 -20 years depending upon the canopy.
- Same insecticide should not be used repeatedly. It is better to alternate equally effective insecticide for each spray.
- Empty chemical container should be destroyed by puncturing / cutting into pieces and buried into the soil.
- Drinking water source should not be contaminated while spraying.
- Cloth mask covering nose and mouth should be invariably used by the person who attends to spraying.

Conclusion

Among the three species of species of *Helopeltis viz., H. antonii*, *H. theivora* and *H. bradyi*; *H. antonii* is the endemic species able to inflict severe damage on cashew. The presence of protease enzyme activity in the salivary secretions of *H. antonii* gives an indication that if the gene for protease inhibitors is incorporated in these host plants through DNA recombinant technology, it may increase biochemical basis of resistance and thereby natural control of *Helopeltis* spp. Can also be improved. Similarly, for biological control with host specific egg parasitoids of *Helopeltis* spp. Have shown some potential in reducing the host population especially in cashew. Since, these parasitoids are specialist parasitoids and not amenable for mass culture, there is a limited scope for augmentation. However, their activities can be increased by evolving proper conservation and enhancement techniques for specialist parasitoids. The vast fauna of spiders and reduviids in cashew suggest the future trust in management of this pest. Since, the presence of sex pheromone communication was well demonstrated in all species of *Helopeltis*, further investigations have to be intensified to identify the bioactive components of sex pheromone and for further synthesis. The synthetic sex pheromone can very well be used as a lure and kill method and as a monitoring tool to undertake insecticidal control in a judicious way especially on cashew and tea. Thereby, indiscriminate insecticidal spray can be avoided on cashew and also the potential risk of pesticidal residues in cashew kernels can be reduced. The non-insecticidal methods like use of synthetic sex pheromone (as lure and kill method) and biological control will have better scope to reduce the dependency on insecticidal control.

MANAGEMENT OF CASHEW STEM AND ROOT BORER

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Cashew farmers experience several hardships in cashew cultivation due to variation in climate, rainfall and also due to severe insect pest incidence which finally leads to significant loss in nut yield. In cashew, several insect pests attack during various stages of the crop and result in moderate to heavy loss of the crop yield depending on level of insect pest population. Out of these pests, two are major insect pests cause considerable yield loss in most of the cashew growing regions of our country. These are a) Tea Mosquito Bug (TMB) scientifically known as *Helopeltis antonii* and b) Cashew Stem and Root Borers (CSRB) scientifically known as *Plocaederus ferrugineus* and *Plocaederus obseus*.

The adults and nymphs of TMB suck plant sap and lead to drying up of shoots and flower panicles, leading to considerable loss during that cropping season. However, incidence or absence of the pest varies over the years. The other pest, cashew stem and root borers infest the vital bark portion of yielding cashew trees and lead to gradual death of such infested cashew trees. The pest population of CSRB increases over the years resulting in constant loss of tree population. Thus, productivity in a given location gets reduced over the years. In this brochure, the symptoms of infestation and various approaches to be adopted for managing this pest is mentioned for the benefit of the cashew farmers of the country.

What is cashew stem and root borer?

The insect is normally noticed by cashew farmers at larval stage which feeds on the bark portions of the stem and roots, by making irregular tunnels which enlarge as the larva grows in size. The farmers can notice larvae, pupae and unemerged immature adults in the damaged portions of infested trees. The adult insects belong to the “beetle” group of insects which have hard and stout body and are strong fliers. The adult beetles of this group have long antennae and are active during the night. Hence, these adult beetles are normally not noticed in the cashew plantations during day time.

What are the symptoms of pest damage?

At the base of the CSRB infested tree, gum and fibrous material are exuded in small quantities in the initial stage of attack. During later stages of attack, the infested tree canopies show a sickly appearance and the green leaves turn yellowish and start dropping prematurely. In the severe stages of attack, the twigs dry off and the bark on the trunk starts splitting. At this stage, large quantity of chewed fibers and gum (commonly known as frass) are seen as big lumps at the base of the CSRB infested tree.

When does the pest incidence occur?

Normally the pest incidence is noticed during the months of Dec. to May in different cashew growing tracts of the country. Different stages of infestation are generally seen all round the year. However, certain stages of the pest are noticed in certain months only. During the onset of rainy season the healthy trees turn dark green, whereas, the infested trees remain yellowish, which is a sure indicator of the pest attack in those trees. During the nut collection period, close observation of the tree bases reveals the initial infestation symptoms which can be treated suitably prior to onset of monsoon.

How does the pest damage the cashew trees?

The adult female beetles lay eggs (which resemble rice grains) inside the crevices of the bark of stem or exposed roots. Young grubs hatch from these eggs in 5 – 7 days and immediately start boring into the bark. The grubs feed voraciously for a period of 6 to 8 months and grow rapidly in size and fill the tunnels with chewed fibre and excreta. Their zigzag feeding interferes with movement of water and nutrients in the tree trunk and root zone leading to premature leaf fall, drying of branches and gradual death of the tree. Full grown larvae make tunnels in the heart wood and form a hard cocoon made of calcium secretions. The pupae stay inside these cocoons for 60 – 90 days and adult beetles emerge from such cocoons and continue the life cycle.

What are the insecticides which can manage the pest?

Several insecticides have been evaluated at various research centers, for over a decade. Some of the insecticides have been recently banned / being withdrawn and hence, alternate effective insecticides were evaluated later on. It is to be noted that any insecticidal treatment without removing the pest stages will not be effective.

The pest stages of CSRB in the infested cashew trees (both in the stem region and in the root zone also) have to be carefully removed by skillful chiseling of the tunnels in the infested portion and destroyed. The larvae will be present on the fresh fiber portion of the tunnels both in the stem and in the roots. The fresh fiber in the tunnels can be traced by their light color while, older fibers will be darker. In case the larvae have entered into the heartwood for pupation, they can be killed by inserting a gear wire / any other bending metal wire and poking into the tunnel till a slushy sound is heard or white fluid flows out. After removing or destroying the larvae and other pest stages, the chiseled portion should be swabbed thoroughly with chlorpyriphos (0.2%) solution and the same needs to be drenched onto the soil near the root zone. This has been proven to minimize the re-infestation by the pest.

Repetition of the treatment should be done, if fresh pest infestation symptoms occur after 30-45 days. Another point to be borne in mind is not to damage more than 50 per cent of the bark circumference, as this will lead to girdling and death of the treated tree. In case, more than 50 per cent of the bark circumference has been damaged or the leaf canopy has yellowed, such trees should not be treated, as they do not recover. These trees need to be uprooted and pest stages in those trees should be destroyed. The timber of such uprooted trees should be shifted out of the plantation and can be used as firewood.

How do we prevent the spread of pest infestation?

Two aspects are to be borne in mind to prevent spread of pest infestation;

i) reduction of pest population in a given location and
ii) rescuing the trees in initial stages of infestation.

To achieve these aspects, the CSRB infested trees should be identified in the initial stages of infestation during the nut collection period and marked suitably. Treatment of all such initially infested trees should be done AT A TIME and if possible on a community basis following the method mentioned above. Also, the trees which have yellowing of the canopy and / or have more than 50 per cent of the bark circumference damaged should be uprooted and pest stages in the root zone should be destroyed. This approach is called "PHYTOSANITATION" which helps to reduce the pest population in a given location and leads to lesser fresh incidence of the pest in the subsequent years. Extensive field trials have shown that on adopting this phytosanitary measure, a reduction in the number of freshly infested trees and also a significant reduction in the number of larvae occurring per infested tree could be achieved.

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TRANSFER AND IMPACT OF CASHEW PRODUCTION TECHNOLOGIES

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Introduction

Agricultural extension in India is largely deployed by government, implemented mainly through government institutions and to some extent through non-government agencies. In India, the extension efforts, particularly transfer of technology efforts, have largely been taken up by the state departments of agriculture and other disciplines as a state subject. The Indian Council of Agricultural Research (ICAR) as the apex body to provide new technologies in agriculture and allied aspects has its own transfer of technology activities. The extension efforts of ICAR, particularly through its institutes are largely of frontline extension programmes. Transfer of technology efforts in cashew by ICAR are also mostly frontline in nature while large scale field level extension work being taken up by line departments of various states. This chapter looks at the various approaches, models and methods used in transfer of technology by DCR, Puttur and summarises impact of recommended cashew production technologies.

Transfer of technology methods adopted by DCR, Puttur

The extension efforts of ICAR, particularly through its institutes are largely of frontline extension programmes. DCR Puttur, over its past 25 years of existence has also made such efforts which are mostly frontline in nature. This article takes a look at the technology backstopping efforts made by the institute since its existence.

Participatory Technology Demonstration Plots

To provide technology backstopping to farmers on frontline cashew production technologies developed by Directorate of Cashew Research and other cashew research stations, cashew demonstration plots based on Farmer Participatory Technology Development (PTD) model were laid out at selected farmers' plots. These PTD cashew gardens serve as demonstration plots to prove the effectiveness of the recommended cashew cultivation practices to farmers while for scientists, these demonstration plots are the tools for assessment and refinement of the recommended practices based on the performance of technologies at micro location level. Laying out of farmer participatory demonstration plots started from the year 1988 as part of the research project; "Transfer of Technology Programmes in Cashew" with the following objectives:

i) To provide technology backstopping on frontline cashew production technologies.
ii) To assess, refine and demonstrate the frontline cashew production technologies.

This research project is externally funded by Directorate of Cashew nut and Cocoa Development, Cochin. Under this programme, every year interested farmers are being

selected for demonstrating the frontline cashew production technologies. Interested farmers are requested to apply for the demonstration plots. The application should be addressed to 'The Director, Directorate of Cashew Research', Puttur. In their application, the farmers should mention the root map to their plots. The farmers should have at least two acres of land for demonstration. The plot should be located by the road side, so that the performance of the crop can be observed by the fellow cashew farmers. A team of scientists from DCR assess the plots for their suitability as demonstration plots, after checking the application. Based on report of the team, demonstration farmers will be selected for the particular year. The newly selected demonstration farmers are provided with subsidy and are being trained every year at DCR, Puttur on Cashew Production Technology.

The farmer participatory technology demonstration gardens are regularly visited by the project team and other scientists. The conditions of these plots are assessed based on the criteria viz., removal of forest trees, gap filling, initial training, pruning, soil and water conservation practices, application of manures and fertilizers and plant protection measures. Technical advice is being given to the demonstration farmers based on conditions of the plots.
So far in Dakshina Kannada district a total of 162 model cashew demonstration gardens were laid out. Among the five taluks of the districts, in Puttur taluk more number of plots were laid out and 78 plots were under normal density system whereas remaining 84 plots were under high density planting system. The varieties/types which were distributed as planting material are Bhaskara, VRI-1, VRI-2; Ullal-1, Ullal-3; H-3-13; VTH 174; BLA 139-1; H-3-17; BPP-3; VTH 59/2; VTH 30/4; T.No.40; Selection-1, 2; Goa 11/6; H 32/4; V-4; NDR-2-1 and Ullal-4. PRESENTLY 26 new FLD plots are taken up in tribal farmer plots under Tribal Sub Plan scheme. The technologies demonstrated include recommended varieties and planting densities.

Thematic campaigns

In order to provide intensive training to the cashew demonstration farmers and cashew growers on important aspects of cashew cultivation viz., soil and water conservation measures (terracing and opening of catchpits), plant protection measures (control of TMB and CSRB) and initial training and pruning, thematic campaigns are being organized. These thematic campaigns were organized in collaboration with NGOs like SKDRDP, Dharmasthala; KJP Research Foundation; Sri Durga Charitable Society and Development Departments.

Prior to the campaign wide publicity was given to attract large number of cashew growers. During campaign, the cashew growers were being exposed technologies through different extension methods viz., exhibition, specially prepared literature; lecture-cum-discussion by experts and field demonstration. Mostly these campaigns were organized at the cashew demonstration plots.

All together, 19 campaigns on SWC measures, 17 campaigns on plant protection measures and 4 campaigns on initial training and pruning were organized and the impact of these campaigns were very high.

Attempts were also made by the Directorate to assess the effectiveness of the campaigns by assessing the knowledge level of the participants on SWC and PP measures before and

after the training. It was found that the campaigns were effective in imparting knowledge to the respondents on SWC/PP measures were the number of respondents having higher level of knowledge was more after the training compared to before the training.

Lessons Learnt

- Collaboration with NGO's and village institutions like schools and panchayats encourages participation of the farmers.
- Intensive training using various modes of training increases effectiveness of the programmes.
- These types of programmes serve as a platform in which problems about utilization of cashew and other plantation crops can be discussed and solutions be suggested.

Cashew Field Days / Cashew Days

In order to inform the cashew growers about the latest research developments in cashew and to get the feedback from the farmers about the usefulness of the cashew production technologies disseminated, Cashew Field Days / Cashew Days are being organized either at DCR, Puttur or at the Cashew demonstration plots of progressive cashew growers.
The farmers / cashew growers on the programme day are explained about the research results at respective plots during the field visit. An exhibition depicting the latest developments in cashew research and useful information about cashew also will be arranged using photos, panels, charts, specimens etc for the benefit of the farmers.

After the field visit and exhibition, seminar-cum-discussion are arranged during which experts in cashew research development and progressive cashew growers share their experience with the other farmers. At the end, question answer session is arranged to clarify the doubts of the farmers on various aspects of cashew cultivation and to express their feedback about the usefulness of the technologies. DCR, Puttur has so far organized 20 such programmes for the benefit of cashew growers, of which a total of 3000 farmers were benefited.

Efforts in Capacity Building

1. Training on "Cashew Production Technology"

In order to educate the extension personnel who are working in development departments in cashew growing states training programmes on "Cashew Production Technology" is being organized regularly. This programme is of two types viz., Refresher course and Special course. Refresher course is being organized for three days whereas special courses are being organized for five days. These programmes are open to extension personnel from all cashew growing states.

During the training, the participants will be trained on the various aspects of cashew cultivation through lecture-cum-discussion mode, visit to various experimental plots, visit to farmers' participatory demonstration plots, visit to private cashew nursery and processing industry. So far 50 such training programmes were conducted at this centre, out of which 1300 participants from all over the cashew growing states participated and benefited.

2. Training on "Vegetative Propagation of Cashew"

To meet out the demand for quality cashew planting material (softwood grafts), which is increasing in all cashew growing states, training programme on vegetative propagation of cashew is being organized regularly. During these training programmes theory and practical sessions on softwood grafting technique and nursery management are being imparted to the participants through intensive training for two days. Participants (nursery assistants / supervisors) from development departments and government owned plantations are regularly being deputed for this programme. So far at DCR, Puttur, 51 such training programmes were organized out of which around 650 participants were trained.

3. Training farm women on cashew apple utilization

Cashew apples are rich in Vitamin C and minerals and have many advantageous effects on human beings. Interestingly, only 10-15 percent of the cashew fruits are utilized by processing, that too to produce country made liquor called 'Fenny' only in Goa. The fruit is wasted mainly due to its disliking qualities such as astringency and arid principles since the fruits are rich in tannin which causes throat and tongue irritation after eating. But the fruits can be made suitable for consumption by removing the undesirable tannin and preparing value added products such as clarified juice, syrup, squash, canned fruits, pickles, jam, jelly and chutney. With this aim DCR, Puttur initiated training programmes on 'Cashew apple utilization' with farm women as the target audience.

During the training the trainees will be imparted training through participatory learning (ie) 'learning by doing'. In addition to this literature on cashew apple utilization will be provided to the trainees. The method demonstrations so far organized were on cashew apple preparation viz., juice/squash, jam and chutney. So far four such programmes were organized out of which a total of 293 farm/rural women were trained.

When the impact of these programmes were assessed by using post-exposure questionnaire (31 respondents) and through mailed questionnaire (20 respondents) it was found that the home level adoption of the demonstrated products was at a average of 50.00% whereas the large scale adoption was poor. The reasons quoted by the respondents for non adoption of the products at a large scale were no awareness about the information on establishment of small scale units, no adequate facilities, non availability of adequate quantity of cashew apples, no adequate time, poor economical background and marketing problems.

4. Other training programmes

Apart from these, training on IPM in Cashew, pruning in cashew and composting of biomass, cashew apple utilization, soil and water conservation in cashew and high density planting and pruning in cashew are also provided. So far, eleven such trainings were conducted covering more than 400 farmers and officials. The Directorate also conducts training programmes on request, apart from the trainings provided under the routine schedule.

Production and supply of planting material

In order to produce and supply quality planting material for cashew (grafts) to the farmers and development departments, two revolving fund schemes were started at Directorate of Cashew Research, Puttur. These are ICAR Revolving Fund Scheme (at Kemminje campus) and DCCD Regional Nursery scheme (at Shantigodu campus). The ICAR revolving fund scheme is functioning from 1990-91 onwards whereas DCCD revolving fund scheme is in place from 1996-97. So far around 17,00,000 grafts were produced and distributed to farmers and development departments from the two revolving fund schemes.

Other extension efforts

Apart from the above routine approaches DCR also participates in exhibitions/expos at important venues across the country by putting up exhibition stall with posters / charts / live specimens depicting the news, information, technologies developed / available on cashew in the country thus aiding in technology dissemination to visiting farmers and other stakeholders. Scientists and technical staff of this Directorate also participated in the exhibitions for explaining technical information to the visitors.

Field visits / Consultancy / Evaluation programmes were also done by the scientists on request. Team of scientists has visited the cashew plots of farmers in all cashew growing states of India upon request. Scientists also participated in various workshops and seminars on cashew organized at various parts of India and presented paper and delivered lectures on various aspects of cashew cultivation. Periodically team of scientists from the directorate participated in the phone-in programme of Doordarshan (Kannada) on Plant Protection and other aspects of cashew. Various Radio talks were delivered on cashew varieties and other cultivation practices and production technologies. Scientists of Directorate delivered talk on various aspects of cashew cultivation and processing aspects. Television interviews are also given on cashew varieties in other states which were telecast in Hindi also by D.D. News. The Scientists also participated in various State Level Workshops cum Seminars on Cashew and delivered talk on topics like cashew production technology, plant protection and training and pruning in cashew. DCR Scientists also visit the Frontline demonstration plots set up under NHM in other districts and states of the country for evaluation on the same.

Future thrust for transfer of technology

DCR focuses on frontline extension of cashew production technologies in line with the mandate of ICAR. Presently, Transfer of Technology efforts by DCR utilises traditional methods which have only moderate reach. The limited staff available for extension and the approach of frontline transfer of technology will further make it difficult in reaching the cashew production technologies to wider audience. The future thrust is on:

- Utilising advances in knowledge management using ICTs towards better technology realization and transfer of technology. Platforms like mobile telephony are to be utilised by implementing mobile advisory services to cashew farmers.

- Retaining interest of new generation cashew farmers and attracting more of them towards cashew farming is a big challenge. Utilising social media marketing by reaching

them through innovative social media platforms like Facebook and Twitter is to be explored in this regard. Transfer of technology efforts of DCR has to be made available on social media platforms for increased reach and effective transfer of technology.

- Better utilization of advances in social capital research has to be made towards social mobilization for formation of cashew farmer groups aiding in participatory transfer of latest cashew production technologies.
- Identification of sustainable cashew based farming systems through extension research will prove to be beneficial towards planning meaningful outreach activities for overall improvement of cashew farmer livelihoods.
- Knowledge about technology fatigue existing in the Cashew sector is presently not much available. More emphasis has to be given for extension research and the knowledge about technology fatigue has to be made available in the coming years. This, along with advances in participatory research has to be used towards successful technology backstopping in the future.

Impact of recommended cashew production technologies.

The cashew cultivation in India mainly confines to the states of Kerala, Karnataka, Maharashtra and Goa along the West Coast and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the East Coast region. It is also grown in plains like Chhattisgarh, Gujarat, Bihar and Northeast Hill Regions like Meghalaya, Manipur and Tripura and also in Andaman and Nicobar Islands. In India, it is cultivated in an area of 9.82 lakh ha with a production of 7.28 lakh tonnes and productivity of 772 kg/ha. India has the maximum area (21.6%) under cashew nut and is the third largest producer (17.3%) of raw nuts in the world. After Vietnam, the country is the second largest exporter, accounting for 34 percent of the world's export of cashew kernels. As far as Karnataka State is concerned, Dakshina Kannada District is the major cashew producing region. Increasing production in this district will contribute largely for the Karnataka state's production. Cashew cultivation receives dwindling importance in Dakshina Kannada District in relation to the prices of other crops like arecanut, cocoa, rubber and coconut.

To improve the cashew cultivation scenario of major cashew-growing regions, assessment of the impact of recommended cashew production technologies are very important. Hence, to explore the applicability of technology impact premise in the context of Cashew cultivation, the present study was undertaken at DCR with the objective to measure the impact of different varieties on area, production and productivity of cashew and to measure the impact of recommended production technologies on cashew production and productivity in Dakshina Kannada district of Karnataka. Purposive sampling technique was used to select Dakshina Kannada district since it is a major cashew producing area of Karnataka with presence of two research stations besides other development departments working on cashew and hence having better chances of technology utilization at farm level. Farmers from all the five taluks of the district namely Mangalore, Buntwal, Puttur, Belthangady and Sullia represented the sample.

An 'ex-post-facto cause to effect' design was applied. Detailed questionnaire measuring the adoption status of the farmers, along with their profiles, was developed, pre-tested and utilized for the study. The questionnaire contained 123 questions and took about 45 minutes to elicit information from one household. The data were collected during the 2012-13 through questionnaire and personal interviews. Appropriate statistical measures such as Phi,

Spearman's rank correlation and regression analysis were employed to arrive at conclusions. Data was analyzed using Microsoft Excel 2007 and IBM SPSS Statistics Ver. 20.

Adoption and Impact of different varieties on cashew area

Results of the study on impact of recommended varieties on total cashew area showed that highest area under cashew is covered by the variety Ullal-3 (41%) followed by variety Bhaskara (26.62%). It may also be noted that adoption pattern also shows similar trend with variety Ullal-3 adopted by 59 per cent of farmers followed by variety Bhaskara (55%). Most farmers have adopted a minimum of two cashew varieties in their field and 'Ullal-3 + Bhaskara' combination emerges to be the most popular one in the study area. Varieties Ullal-1 and Vengurla-4 (V-4) were found to cover around 8 percent each of rest of the area. But, these varieties are not popular among farmers with only 13 and 4 percent farmers respectively adopting the said varieties in the district.

Table 1: Variety wise adoption and impact on cashew area

Variety	Adopted by (% farmers) *	Rank	Area covered (%)	Rank
Bhaskara	55	2	26.62	2
NRCC Seln-2	19	3	5.21	5
Madakkathara-2	4	8	4.62	6
Ullal-3	59	1	41.00	1
Ullal-1	13	4	7.66	4
Ullal-4	11	5	2.93	7
VRI-3	7	6	2.66	8
V-4	5	7	8.43	3
V-7	4	8	0.75	9
Other varieties	3	-	0.09	-
Total	92**	-	99.96	-
Seedling origin	8	-	0.04	-
** the percentages won't add upto 100 due to adoption of multiple varieties by single farmer* *** represents total percentage of farmers who have adopted released varieties*				

Other varieties like NRCC Selection-2 (5%), Madakkathara-2 (4%), Vridhachalam-3 (VRI-3) (3%), Ullal-4 (3%) and Vengurla-7 (V-7) (1%), have low impact on total cashew area. In total, improved varieties were found to be adopted by 92 percent of the farmers while 8 percent were still continuing with seedling origin plantations. However seedling origin plantations have only negligible coverage in farmer fields (0.04%). Variety wise adoption and impact on area is given in figure 1.

Impact of cashew varieties on production and productivity

Analysis of variety wise impact on cashew production showed that farmers realized highest yield from variety Bhaskara (4.73 kg/tree) followed by Madakkathara-2 (4.45 kg/tree). This was followed by Ullal-1 (3.90 kg/tree) and Ullal-3 (3.87 kg/tree). Ullal-4, another

recommended variety was at fifth position with a yield of 3.67 kg/tree while NRCC selection-2 fared low at sixth place with 3.47 kg/tree. Productivity under normal density (8x8m) as well as high density (5x5m) planting was highest for Bhaskara (737.88 & 1882.54 kg/ha) and Madakkathara-2 (694.20 & 1771.10 kg/ha). This was followed by Ullal-1 (608.40 kg/ha), Ullal-3 (603.72 kg/ha) and Ullal-4 (572.52kg/ha) under normal density. Under high density planting system, Ullal-1 (1556.10 kg/ha), Ullal-3 (1540.26 kg/ha) and NRCC Selection-2 (1374.12kg/ha) stood respectively at third, fourth and fifth positions. High density plantations of Ullal-4, VRI-3, V-4, V-7 and other varieties were not observed during data collection for this study. Variety wise impact on production and productivity is presented in table: 2.

Table 2: Varietal impact on production and productivity of cashew

Sl. No	Variety	Production (kg/tree)**	Rank	Productivity (kg/ha) under normal (8x8m) density	Rank	Productivity (kg/ha) under high (5x5m) density	Rank
1.	Bhaskara	4.73	1	737.88	1	1882.54	1
2.	NRCC Seln-2	3.47	6	541.32	6	1374.12	5
3.	Madakkathara-2	4.45	2	694.20	2	1771.10	2
4.	Ullal-3	3.87	4	603.72	4	1540.26	4
5.	Ullal-1	3.90	3	608.40	3	1556.10	3
6.	Ullal-4	3.67	5	572.52	5	-	-
7.	VRI-3	3.06	7	477.36	7	-	-
8.	V-4	1.51	9	235.56	9	-	-
9.	V-7	3.00	8	468.00	8	-	-
10.	Other varieties	2.23	-	347.88	-	-	-
11.	Seedling origin	1.23	-	147.60	-	-	
** *In trees above 5 years of age*							

Bhaskara variety was released during March 2006 for coastal region of Karnataka. This variety is having midseason flowering habit (Dec-Mar) with a flowering duration of 60 days and has potential to escape from the attack of the tea mosquito bug (TMB) under low to moderate outbreak situation. The average yield was reported to be 10.7 kg/tree at DCR. The nut and kernel weight are 7.4 g and 2.2 g respectively. The shelling percentage is 30.6 and kernel grade conforms to export grade W240. The potential to escape from the attack of the tea mosquito bug (TMB) along with very good yield potential have definitely favoured this variety in its high adoption among farmers of Dakshina Kannada district. Madakkathara-2 (NDR 2-1) is a selection released in 1987. The mean yield reported from research station is 17 kg/tree. The nuts are bold (7.3 g nut weight) with shelling percentage of 26.2. Kernel weight is 2g having a count of W 240 export grade. However, this highly yielding variety was found to be adopted by only 4 percent of the farmers mainly due to low awareness in this district.

Ullal-3 is a selection released in 1993 from ARS, Ullal. It is early in flowering (November - January) and fruiting period is very short (50-60 days). The fruiting is from January to March

and sometimes starts from last week of December. It is a high yielding variety with average yield of 14.7 kg/tree. The nut size is medium with nut weight of 7g. The shelling percentage is 30 and the kernel grade conforming to W 210 grade. Its mid season nature coupled with higher yields seems to have made it a favourite among farmers. Ullal-1 is a selection released by ARS, Ullal in 1984. The average yield is 16 kg/tree. The duration of harvest is long (about 110 days). The nut weight is 6.7g with shelling percentage of 30.7. Even though the variety recorded slightly higher yields (3.90 kg/tree) in field compared to Ullal-3 (3.87 kg/tree), the adoption by farmers (13%) was found to be far below than its counterpart Ullal-3 (59%) which tops in adoption among farmers in all varieties.

Production and productivity profile of cashew farmers

The production and productivity profile of cashew farmers showed that farmers achieved a mean production of 425 kg and productivity of 2.92 kg/tree. In case of production, majority fell in to medium (40%) and low (43%) producer categories while they were almost equally divided into high (33%), medium (36%) and low (31%) categories with respect to productivity achieved.

Table 3: Classification of farmers based on production and productivity of cashew

Categories	Production			Productivity		
	f	%	Range	f	%	Range
High	13	17	>674	25	33	>3.96
Medium	30	40	674-177	27	36	3.96-1.87
Low	32	43	<177	23	31	<1.87
Mean	425			2.92		
SD	497			2.09		

Technology impact on production and productivity of cashew

The recommended cashew production technologies starting with recommended varieties were categorized to eight groups such as Varieties, Planting and initial care, Soil and water conservation, Manures and fertilizers, Pruning and training, Plant protection, Intercropping and Harvesting and post harvest technologies. Their impact on production and productivity were studied separately and are presented here.

Adoption and relationship of cashew production technologies towards cashew production and productivity

The overall adoption of cashew production technologies had received an index score of 44. Majority (51%) of the farmers belonged to medium adopter category while rest was almost equally divided between high (25%) and low (24%) categories (Table 4). Most cashew production technologies scored moderate to poor adoption index with exception of recommended varieties (72) and planting and initial care technology (73). Soil and water conservation technology (48) and pruning and training (43) showed medium adoption index while manures and fertilizers (30), plant protection (20), intercropping (22) and harvesting and post harvest technologies (43) scored low adoption index. Correlation analysis showed

that four technologies; soil and water conservation, pruning and training, plant protection and harvesting and post harvest technologies had highly significant relation with the cashew production achieved by farmers (table 5) while pruning and training had a significant relation with the productivity of cashew.

Table 4: Adoption index of farmers for cashew production technologies

Sl. No	Category	Range	Respondents	
			f	%
1	Low (<Mean-1/2S.D)	<36.27	18	24
2	Medium (Mean(+/-)1/2S.D)	36.27-51.39	36	51
3	High (>Mean+1/2S.D)	>51.39	19	25
Mean= 43.83, S.D=15.12				

Cashew farmers were found to adopt maximum practices under planting and initial care (Rank 1) followed by recommended varieties. Also, these practices were easy to adopt and initial interest plays a major role in the high adoption rate of this technology. Soil and water conservation techniques were also moderately followed by most of the farmers (Rank 3). The increased availability of heavy machineries at affordable per hour rates for land leveling, pit digging, terrace making etc. is a major reason behind this. Also, the practices under this technology are mostly adopted along with or in continuance with planting and after care thereby increasing its chance of adoption due to initial interest. Accordingly, the technology also showed a positive significant relationship (r=0.344**) with cashew production achieved by farmers. Adoption of pruning and training along with harvesting and post harvest technologies stood together at fourth place with adoption index of 43. Pruning and training was also found to have significant relationship with production (r=0.338**) as well as productivity (r=0.271*) of cashew. Harvesting and post harvest technologies was also found to have highly significant relationship with production (r=0.321**). Adoption of manures and fertilizers was found to be poor among farmers with adoption index of 30. Intercropping was another technology which was poorly adopted (Rank 6). Low to medium adoption with respect to most cashew production technologies could be attributed to the fact that farmers are yet to realize the importance of recommended technologies on the yield and potential economic benefits that accrues from their adoption.

Table 5: Relationship of cashew production technologies towards cashew production and productivity

Technology	Adoption Index	Production	Productivity
		'r' value	'r' value
Varieties	72	0.174 NS	0.020 NS
Planting and Initial Care	73	0.201 NS	-0.011 NS
Soil and Water Conservation	48	0.344**	0.165 NS
Manures and Fertilizers	30	0.094 NS	-0.042 NS
Pruning and Training	43	0.338**	0.271*
Plant Protection	20	0.345**	0.146 NS
Intercropping	22	0.062 NS	0.014 NS
Harvesting and Post Harvest	43	0.321**	0.123 NS
Overall adoption	44	-	-
NS – Non-Significant, ** - Significant at 1 % level, * - Significant at 5 % level			

Plant protection, which is one of the most important components affecting production, scored the lowest adoption index (20) among cashew farmers in the present study. Non-adoption was particularly high for plant protection technologies against Cashew Stem and Root Borer

(CSRB) due to the complexity of the technology while majority had adopted measures against Tea Mosquito Bug (TMB) due to less complexity, higher trialability and observability of results in comparison to measures recommended against CSRB. The technology showed highly significant positive relation (r=0.345**) with cashew production. It is obvious from these findings that there is tremendous scope in the region for increasing adoption of recommended cashew production technologies.

Contribution of cashew production technologies towards variability in cashew production and productivity

Regression analysis revealed the extent of contribution of each production technology towards variability found in levels of cashew production and productivity in the district (Table 6). Plant protection component which scored the lowest adoption index and also showed highly significant relation (r=0.345**) with cashew production achieved by farmers emerged as the most significant contributor towards cashew production (b=0.339**) in the district. This clearly indicates that adoption of plant protection techniques cannot be ignored at any cost if cashew production in the district has to be improved. The findings also calls for development of plant protection measures which are user friendly (less complex), having relative advantage over existing technology and also compatible with farmer situations. Soil and water conservation technology which showed a significant relationship (r=0.344**) with cashew production, is also found to have a significant contribution towards explaining the variability in cashew production (b=0.326*). Interestingly, intercropping; another poorly adopted technology was also found to have a significant contribution towards explaining the variability in cashew production (b=0.243*). Recommended varieties, manures and fertilizers and harvesting and post harvest technologies were found to have a non-significant but negative contribution towards cashew production. This is explained by the fact that in case of recommended varieties, even though the study found that highest production was given by Bhaskara, Madakkathara – 2, Ullal - 1 and Ullal - 3 varieties, the same varieties covered only 26.62, 5.21, 7.66 and 41.00 percent respectively of total area under cashew cultivation. Thus, the findings make it clear that by increasing the adoption and area coverage of above varieties we can bring a quantum increase in cashew production in the district.

Table 6: Contribution of cashew production technologies towards variability in cashew production and productivity

Technology	Production	Productivity
	'b' value	'b' value
Varieties	-0.131 NS	-0.077 NS
Planting and Initial Care	0.037 NS	-0.159 NS
Soil and Water Conservation	0.326*	0.208 NS
Manures and Fertilizers	-0.195 NS	-0.184 NS
Pruning and Training	0.178 NS	0.313*
Plant Protection	0.339**	0.139 NS
Intercropping	0.243*	-0.097 NS
Harvesting and Post Harvest	-0.012 NS	0.024 NS
	R^2 = 0.406	R^2 = 0.149
NS – Non-Significant, ** - Significant at 1 % level, * - Significant at 5 % level		

Farmers in the study area were found to have poor adoption in case of manures and fertilizers for cashew. The study also found that harvesting cashew from the trees itself is a common practice to avoid theft and this coupled with improper drying practices including less

number of drying days has contributed more volume to the cashew production. If proper harvesting and drying practices are followed it will decrease the total volume of cashew thus explaining the negative relation. Similarly by increasing the adoption levels of manures and fertilizers in cashew and by adopting proper harvesting and post harvest drying techniques the cashew production can be further improved. All the recommended production technologies together could explain only up to 40 percent of variability in cashew production (R^2 = 0.406). Adoption of pruning and training in cashew orchards was found to have a significant contribution towards increasing the per unit productivity of cashew orchards. However the adoption level of this technology is very low at present. The study reveals that increasing adoption of soil and water conservation techniques and development and popularization of user friendly plant protection measures can contribute largely to increased cashew production while increasing adoption of pruning and training in cashew orchards can significantly increase the per unit productivity of cashew orchards. The results clearly indicate that socio-economic and bio-physical factors along with policy environment have a larger contribution in explaining cashew production and productivity and technology component alone cannot be expected to bring a positive impact. Understanding the above dynamics in technology impact can help researchers and extension agencies working in cashew sector to design better innovations and effective outreach strategies.

Socio-economic impact of cashew cultivation

Ten major social and economic impact indicators were studied to arrive at the socio-economic impact of cashew farming among the respondents. Study on impact on cropping pattern didn't record much of change with only 17 percent of farmers increasing area under cashew over the years (1.5 acres) while only negligible percent (3%) of them purchased new lands (2 acres) for cashew cultivation. Impact on labour engagement was also low with only 20 percent farmers hiring labour for cashew and only one tenth of them opting for increased family labour engagement (11%). The hiring of labour was noticed particularly for plant protection and harvesting operations with farmers mostly engaging one to two labourers during this period. While a large majority (85%) reported no change in farm expenditure due to cashew cultivation, 43 percent of farmers reported an increase in farm income due to cashew cultivation. Farmers reported an average increase of Rs. 2272/year in farm expenditure and Rs. 4188/year in farm income due to cashew cultivation. Resultant increase in family incomes was also reported by 36 percent of the farmers to the average of Rs. 4259/year followed by an average increase of Rs. 2666/year in their family expenditure. The above indicators were measured as average for preceding 10 years of cashew cultivation.

Analysis of social impact presented a better picture in comparison to economic impact with majority (61%) of the farmers reporting increased social participation while nearly two-third (67%) majority could increase their contacts with extension agencies and research institutes due to cashew cultivation. Majority (56%) reported increase in their mass media exposure while a large majority (63%) reported an increase in their opinion leadership status due to cashew cultivation. It can clearly be seen that the social benefits of cashew cultivation are far more than the economic benefits.

Classification of cashew farmers based on the social and economic benefits accrued shows that nearly half of the cashew farmers (47%) belong to high social impact category while in case of economic impact large majority (80%) belonged to low benefits category. Overall, nearly half of the cashew farmers (47%) recorded medium levels of socio-economic impact

(Table 16). It may be noted that the low level of economic impacts are compensated to a large extent by the high social impact due to cashew cultivation.

Constraints faced by farmers in cashew cultivation

The socio-economic impact of cashew cultivation is largely influenced by the constraints faced by farmers. Studies conducted by DCR revealed 12 constraints as reported by farmers and are classified under technical, management, economic/marketing and processing constraints. Majority (83 %) reported poor price and the high price fluctuations in market for raw cashew nut as the major constraint (Rank 1). Lack of cashew farmer associations/groups and availability of cashew nuts from African nations allow cashew nut processors to manipulate the raw cashew nut prices. Low availability of hired labour was the second biggest constraint reported (71%). Migration of workforce to urban areas, easy job availability through MNREGA scheme and respectable job avenues in many private firms for women have acted as reasons for low availability of workforce in villages. Attack of tea mosquito bug and resultant crop loss (41%) and death of yielding trees due to cashew stem and root borer attack (35%) were also major technical constraints (Rank 3 & 4). This is a matter of concern since cashew yields are largely influenced by the attack of Tea Mosquito Bug (TMB) while attack of Cashew Stem and Root Borer (CSRB) eliminates the crop itself.

Flower drying (Rank 5) and poor yield in some varieties (Rank 6) like NRCC selection-2 (flower drying), VRI-3, V-4 and V-7 (poor yield) were also major constraints. Problems in collection of nuts from large plantations and the resultant theft due to delay or inaccessibility was another constraint reported by farmers. Price control and manipulation by cashew processors were also identified as a constraint by certain section of farmers. Cultivation of cashew in poor soils and wastage of cashew apple due to lack of processing avenues were the other constraints cited by farmers.

PROCESSING AND PRODUCT DIVERSIFICATION IN CASHEW APPLE

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The cashew apple, formed by the swollen pedicel is an important produce of cashew tree. Yield of cashew apple in six to eight times that of the cashew nut. The production of cashew apple in India is estimated as 0.6 to 0.7 millon tons per annum (Sobhana and pushpalatha, 2014). This natural resource is totally wasted in the country, expect in Goa where it is commercially exploited for production of feni.

Strengthening processing and value addition of cashew apple is the only alternative to control the waste of this nutritionally rich natural resource. Ripe cashew apple is soft, fibrous and has a characteristic ehavi. It is a rich source of Vitamin C, often several times more than citrus fruits (Ohler, 1979). Cashew apple juice is known to have anti scorbutic properties and is used as a diuretic. It is also useful for kidney ailments and cholera. Cashew apple contains 12.3 per cent carbohydrates, 0.2 per cent proteins, 0.9 per cent fibre and 0.2 per cent minerals (CSIR, 1985). The ascorbic acid content ranges from 170-350 mg per 100 g of apple (Champakam,1983). Cashew apple juice contains 10.7 per cent sugars and has an acidity of 0.3 per cent. Glucose and fructose are the major components of sugar (Rao, 1984). Cashew apple is comparable with several other fruits in content of most of the nutrient but superior in Vitamin C and riboflavin.

The astringent principles present in cashew apple gives an unpleasant biting taste when used in the raw form and limits the use of cashew apple as a table fruit. Apart from the presence of astringent principles which limits its use in the raw form as well as processed product, cashew apple as a commodity has other limitations as well. It is highly susceptible to physical injury which leads to microbial spoilage within a very short period after harvest. The storability of cashew apple is thus very poor and complete spoilage can occur within hours after harvest. Ripe apples are also subjected to damage by insect and non-insect pests. Fragmented and scattered nature of cashew plantations also creates problem in collection and utilization of cashew apple (Balasubramaniam, 1977; Nanjundaswamy *et al*., 1984). The system of collection of cashew nuts from fallen fruits after considerable delay also limits the availability of quality cashew apple for processing purposes.

The apple show great is variability with respect to size, colour, TSS, ascorbic acid, proteins, tannins, specific gravity, juice recovery *etc* (Chandran and Dhamodharan, 1985 , Ghosh and Kuadu, 1989, and Kutty M.C, 2000). Hence varieties suitable for different products are to be identified and used for getting quality. Kumar and Aravindakshan (1985) listed K-27-1, Anakkayam-1, Madakkathara-1 and Sawantwadi as the varieties suitable for processing. According to Kutty (2000), varieties H-1593, H-1600, V-4, K-19-1, Madakkathara-2, Dhana, Kanaka and M 26/2 have desirable attributes with reference to quality parameters. Amrutha, Anakkayam-1, Dharasree and V5 are identified as suitable varieties for preparation of candy and tutty frutty (Suman 2005).

To overcome the availability of cashew apple as raw material for processing, technology for long term storage of cashew apple and its primary processed forms has been standardized at Cashew Research Station, Madakkathara under Kerala Agricultural University. Technologies has also been developed for commercial production of different cashew apple products. The technologies are yet to become popular, for which technology dissemination programmes are to be taken up. It is a proven fact that self help groups of women can successfully run the cashew apple processing units. Eventhough major quantity of production of cashew apples are wasted, a limited quantity is used for direct consumption and product development.

Post harvest problems.

Fruits have special significance to human health as protective food due to their vitamin and mineral contents. They are highly perishable and begin to deteriorate immediately after harvest mainly because of their high moisture content. The post harvest spoilage of fruits is attributed to the continuing physiological activities like respiration and transpiration which result in the degradation of stored energy and loss of moisture. Shriveling, wilting, spoilage by micro organisms, loss of texture, etc are the symptoms of deterioration and perishability. Cashew apple is a non climacteric fruit and is usually collected after falling on the ground along with the nut. This increases the chances of bruising and further damage by micro organisms leading to fermentation and deterioration. Since many of the fruits are seasonal, long term storage techniques are needed for the availability of raw material and product preparation throughout the year. Cashew apple is such a fruit and is available mainly during December – May. All these are to be looked in to during the post harvest handling and preservation of cashew apple.

Cashew farmers miss the opportunity for enhanced income generation since they sell raw nuts to traders and completely wasting the nutritious cashew apple. The seasonal production of cashew apple is one of the greatest handicaps for the processing industry, along with its unpleasant biting sensation when used in raw form and limits the use of cashew apple as a commercial table fruit. KAU has standardized the value addition technologies in cashew apple for the first time in India and rather value addition in the commonly wasted pseudo-fruit of Kerala. The seasonal production, one of the limitations in cashew apple processing, is overcome through long term storage techniques developed by Kerala Agricultural University. Technologies are also standardized for the removal of the unpleasant biting sensation of raw cashew apple before processing, which limits its use as table fruit. Though various techniques are available to process the fruit into various products, they are yet to become popular among the common man. By effective utilization of cashew apple on a commercial scale, the farmers can be assured of increased income, in addition to the income from nut, which definitely will encourage them to take up cashew cultivation with profound interest. Large number of technologies has been developed by various research stations in India, more specifically Cashew Research Station, Madakkathara, for the economic utilization of cashew apple by processing it into various value added products.

Uses of cashew apple

i) Direct Consumption

Cashew apple, because of its attractive shape and colour tempt every body to consume it. However several reasons limits its direct consumption. The astringency due to tannin content is one of the reason which produce an irritation in the mouth while consumption. The addition of salt, chilli powder, spice powder etc help to increase the taste level of raw apple. Minimally processed cashew apple can catch a niche market, provided suitable technology for short term storage is developed.

ii) Primary processing and preservation

Primary processing is adopted for immediate preservation of produce for future use when they are available in large quantity. Cashew apple being seasonal and highly perishable primary processing is inevitable.

Generally ripe cashew apples are primarily processed into juice and pulp while green apples are preserved in salt.

Ripe cashew apples

i) Juice

Extraction and preservation: The ripe apples are washed well preferably in 3% salt solution. Juice is extracted with the help of hydraulic press and filtered. De-tanning is to be done to remove the astringent principles from the juice. An efficient method of de-tanning and clarification (Mini and Mathew, 2008) of cashew apple juice for beverage preparation involves addition of 5g powdered sago (as paste) per litre of the juice and keeping for 12 hours. The upper layer of the clear juice is decanted carefully without mixing with sediments. This juice is preserved by addition of 2.5g Potasium meta Bisulphite (KMS) and citric acid per litre of juice.

ii) Pulp

Pulp is prepared from ripe cashew apples. The cleaned apples are dipped in 5% salt solution for three days for de-tanning by changing water every day. Fourth day, the fruit are taken out washed thoroughly and stored in KMS 1% salt solution. The apples are taken out from KMS solution, washed well in water, pressure cooked and pulped with the help of pulper. It is better to store the apples as such and prepare pulp as when required.

Green cashew apples

Green cashew apples are de-tanned in the same way using 8% salt solution. They are taken out, made into pieces and preserved in salt.

The primary processed products are used for product development.

3. Product development

i) Juice based products

The products based on juice, that possess commercial value are syrup, RTS and carbonated drink. They possess nutritious and refreshing properties. Syrup contain 276 mg Vitamin C and drink contain 140 mg vitc/100 g

Syrup is prepared by adding 65 % sugar while RTS and carbonated drink contain 12% sugar. Carbonated drink is prepared by adding chilled carbonated water at 100psi to the required quantity of syrup.

As the sugar content in syrup is high, it will act as a preservative. The KMS and citric acid in the juice will also provide preservation quality.

Pasteurization is to be given for RTS for getting a shelf life of 3 months. The CO_2 in the carbonated drink itself is a preservative.

ii) Pulp based products

Cashew apple jam

Blending is another technique used in food processing to increase the acceptability of products. The jam prepared with cashew apple pulp blended with 50% mango pulp was more acceptable than that prepared with cashew apple alone.

Cashew apple halwa and candy

Halwa and candy are semi moisturized products, prepared using the technology of dehydration. Halwa is made by mixing coconut milk, sugar and ghee with pulp and concentrating to the desired consistency by heating. Nowadays the technology of vacuum concentration is gaining momentum as the sensory and nutritional quality of the product will be well preserved.

Candy is prepared by progressively increasing the sugar content de-tanned cashew apple by dipping in sugar solutions of brix from 30 to 70^0. One kilogram of cashew apple on processing will give 745g of candy

iii) Green cashew apple product

Cashew apple pickle

Cashew apple pickle is a product which gained high marketability. It is prepared and preserved using salt, oil and vinegar. Green cashew apples are pickled like any other pickle adopting lactic acid fermentation. Primary processing of cashew apple is very important for pickle making.

iv) Products adopting fermentation technology

Cashew apple can be utilized for the manufacture of the fermented products like wine, vinegar, liquor and alcohol. Cashew apple vinegar can be prepared by alcoholic and subsequent acetic fermentation of juice. Cashew liquor is made by distillation of the pure juice of cashew apple without addition of any extraneous matter. Kerala Agricultural University has standardized the method of producing four different grades of liquor from cashew apple.

Cashew apples are utilized widely in Goa for the preparation of the liquor, feni, by distillation mostly through crude country methods on cottage industry basis, in almost all plantations.

Cashew wine is a product of fermentation of hexose sugar of cashew apple juice by intact yeast cells to form ethyl alcohol and carbon dioxide. Kerala Agricultural University has developed methods for producing four grades of wine such as soft, medium, hard and sweet, based on the alcohol percentage and sweetness.

Cashew apple wine can be mixed with fresh juices of orange, pineapple, tomato, grape and cashew apples as well as tender coconut to serve as good health drink as they contain both wine with its medicinal properties and fruit juices with high amount of nutrients and minerals.

Cashew apple powder

The technology for production of cashew apple juice powder has not been standardized. However osmotically dehydrated cashew apples can be powdered to obtain cashew apple powder. 1kg of good quality fresh cashew apple on processing can yield about 200 g of osmotically dehydrated cashew apples. Ready to serve beverage mix, fruit- milk/milk shakes, ice creams, ice candy mix, etc. can be prepared from clarified juice by homogenization, spray drying and mixing with fruit/milk powder as required.

Different confectionery products and culinary products can be prepared using cashew apple. Cashew apple is also reported to have medicinal properties neutraceutical application and agricultural uses.

Cashew apple waste utilization

Cashew apple is used for preparation of ehavi compost animal feed and pest management. A valuable by- product that can be obtained from cashew apple waste is pectin. Pectin is used in manufacturing jams, jellies, marmalades, preserves etc. the yield of pectin from cashew apple varies from 1.60 to 2.03%. the cashew apple pomace of the fruit waste has been identified as ideal medium for pectinase enzyme (Venkatesh, 2003).

Primary requirements to start cashew apple processing unit

A building with adequate area according to turnover envisaged and having electricity and water connection are mandatory for starting a commercial production unit. Apart from

utensils gas connection etc minimum equipments and machineries are required to facilitate primary processing, storage, processing and value addition of cashew apple as given below.

The infrastructure facilities developed for processing of cashew apple can be used for processing of other fruits. . This will help maximum utilization of infrastructure facility developed. Cashew being seasonal in nature, the availability of raw material round the year will be a problem and processing of other fruit based products can be thought off. Also the products including that of cashew apple can be produced and marketed according to market demand. Hence the basic knowledge on processing and value addition of fruits in general is required to run the unit profitability.

Apart from these common value added products, there are certain novel dehydrated products, prepared from cashew apple and may reduce the problems faced by traditional products

Osmo-dehydration

Cashew apple could be dehydrated and stored under ambient condition for a period of six months without affecting the quality by adopting the technique of osmotic dehydration. Compared to the previous processing techniques, this dehydration technique can be considered as a useful technique for the production of safe, stable, nutritious, tasty, economical and concentrated foods, which contain no sugar and can be ehavior on under Intermediate Moisture Food.

Osmotic dehydration is a useful technique for the concentration of fruit and vegetables, realized by placing the solid food, whole or in pieces, in sugars or salts aqueous solutions of high osmotic pressure. It gives rise to at least two major simultaneous counter-current flows: a significant water flow out of the food into the solution and a transfer of solute from the solution into the food. Dept of processing Technology, College of Agriculture, Vellayani has standardized osmotic dehydration technique for cashew apple.

Osmo-dehydration of cashew apple involves three phases.

Phase I- Good quality fruits are made into 10 mm slices, subjected to blanching and osmotically dehydrated by dipping them in aqueous honey solution of 60^0 brix at 50^0 C for 24hour, so that about 50% water from the fruits migrates to honey syrup.

Phase II- Vacuum or air drying – Fruits are drained and dehydrated to 15-20% moisture by vacuum or air drying depending on the cost considerations.

Phase III- Packaging- The dehydrated fruits are packed under modified atmospheric condition with nitrogen in flexible laminated pouches.

1. Spray drying

All types of cashew apple beverages from Kerala Agricultural University are produced by addition of varying concentration of sugars to clarified cashew apple juice. High concentration of sugar and problems in transportation and storage are the main drawbacks of this traditional system of beverage production. Spray drying is one of the best answers to these problems, where the juice is directly converted into solid or semi-solid particles using the machine, spray drier. This novel dehydration method has better control of the process and it increases the product quality. Among the drying techniques, spray drying is used in a wide range of products in food industries to produce dry powders and microcapsules.

Dehydrated cashew apple powder can be prepared with and without cashew apple juice. The cleaned fruits are soaked in 2% salt solution for tannin removal, taken out and rinsed in water. After surface drying, the fruits are sliced, steam blanched and treated with sulphur dioxide. Then juice is extracted, clarified, spray dried and packed as cashew apple powder with juice. The pulp or the residue of apple, obtained after juice extraction, can be dried, powdered, sieved and packed as cashew apple powder without juice.

2. Products from dehydrated cashew apple powder

Frozen desserts and dairy confectionery prepared by optimization of juice concentration and spray drying open an excellent avenue for cashew apple ehavior on. The only constraint here is the large capital investment required for spray drier equipment. Technical expertise and multiple use of the machines for a variety of agro- based products are a must for the year round profit from such enterprise.

Conclusion

The research efforts bestowed for utilization of cashew apple have resulted remarkable achievements especially the work done at Cashew Research Station, Madakkathara (KAU). The research and technology dissemination in this area is to be strengthened to increase cashew apple utilization and prevent the loss of their natural resource.

While analyzing the situation of value addition of fruit crops, it is understood that emphasis has been given in the past only to major fruit crops in the country and the wealth of indigenous fruits has not been brought to the forefront. But in the present scenario of changing food habits, job profile and health awareness, new and improved processed products are in demand world over. To satisfy this demand, there is a constant search for and an effort to develop products from hitherto little sources. In this regard, Kerala offers exciting possibilities of adding new dimensions to the processing industry. Consumers have become increasingly conscious on the health and nutritious aspects of their food and tendency is to avoid synthetic foods and choose nutrition through natural resources. Indigenous fruits such as cashew apple, which are at present underutilized, have an important role to play in satisfying the demand for nutritious, delicately flavoured and attractive natural foods of high therapeutic value.

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CASHEW NUT PROCESSING

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The economic interest has made many countries of the world to encourage the cultivation of cashew and it is fast becoming an export produce in many developing countries. Among horticultural crops, cashew has been known to provide very high economic returns. The raw cashew are either exported or processed prior to export. The cashew kernel is the main product which has aroused economic interest in the wide spread cultivation of cashew. The kernel is widely consumed as snacks and used as a basic ingredient for confectionaries in most countries of the world because of its good nutritive value. Primarily raw nuts, cashew kernels and cashew nut shell liquid (CNSL) are the three main cashew products which are traded in the international market. The importance of cashew (*Anacardium occidentale* L.) for the Indian economy has been due to its role as an earner of foreign exchange and also to its employment generating capacity in the processing sector. Cashew processing in India started as a small cottage industry and has developed into a highly organized labour intensive industry and gradually progressing towards mechanization. Since the world demand for cashew kernels has been rising steadily for several years in the past conferring significant price increase, the processing of cashew remains still a highly profitable industry.

Cashewnut processing industries:

India is the largest producer, processor and exporter of cashew in the world. There are about 3750 cashew processing factories employing more than 10 lakh personnel with an estimated processing capacity of 20 lakh TPA. Export of cashew kernel in the year 2012-13 was around 1.01 lakh MT valued Rs 5063 Crores. Cashew industries have a simple organizational structure and mostly under private management i.e. proprietorship (63%) or partnership (19%). Since it requires large amount of capital investment and working capital, most of the industries depends on commercial banks and state financial agencies. About 62% of the industries are categorized under "Manufacturer exporter". This is primarily due to encouraging export policy and higher exchange value for USD. Tiny processing units i.e. up to 100 TPA and medium capacity processing industries i.e. 100-500 TPA accounts for 39% and 42% respectively, due to raw nut shortage and financial constraints. In order to run the factory through out the year, 50% of the factories import raw nut during off-season from African countries. About 8.21 lakh MT raw nuts were imported during 2012-13. Most of the industries utilized capacity is below 50%. About 90-95% of women force is employed in these industries at different stages of operation. Total employees strength varied between 50 and 400. Men labourers are involved in drying, stacking, roasting, kernel drying and packing. The State Government fixes labour wages and it differs from state to state.

Raw cashew nut:

Raw cashew nut is kidney shaped one with approximately 3.5mm thick leathery outer skin (Epicarp) and thin hard inner skin (Endocarp). Between these two walls of the shell is a honeycomb structure, which contains the phenolic material, commercially, known as cashew nut shell liquid (CNSL). The kernel is inside the shell wrapped in a thin brown skin known as testa.

Raw nut procurement:

Cashew nut is a seasonal crop, harvesting of nuts in India starts from March to June. It has been found that the processors obtain raw material in four ways. I) Directly from producers; ii) Direct purchase from local market; iii) Through commission agents and iv) Through imports. While procuring the nuts, normally 3 tests are conducted.

Visual test:

Size and colour of the nuts to check the maturity.

Floating test:
About 1 kg of sample is transferred to a vessel containing water. After continuous stirring floaters are collected and counted. Mostly immature nuts, due to its lower density than water, improperly filled nuts and deteriorated nuts floats. Based on the percentage of floaters the raw nut quality is assessed.

Cutting test:

Raw cashew nut sample of 1 kg is collected from different bags and mixed together. 1 kg raw nut is taken from diagonal samples and cut open using hand cutting tool. Based on the kernel appearance i.e. white, shriveled, black spotted or rejects, the percentage of good kernel is calculated. This is considered for valuating price of fixing the price.

Cashew nut processing:

It can be defined as the recovery of edible kernel from raw nut by manual or mechanical means. In India, the processing is mostly manual and it consists of moisture conditioning, roasting, shelling, kernel drying, peeling, grading and packing. Cashew shell is pliable and unsuitable for any type of manual or mechanical opening in its natural state. Conditioning or roasting, however, will harden and make cashewnuts brittle, susceptible for cracking or

splitting. Various conditioning methods followed India are: (i) Open pan roasting; (ii) Drum roasting; (iii) Oil bath roasting and (iv) Steam boiling.

- **Drum roasting:**
  In this process the nuts are fed into an inclined rotating drum which is heated initially to such an extent that the exuding oil ignites and burns, thus charring the shell. The drum maintains its temperature because of the burning cashewnut shell liquid (CNSL) oozing out of the nuts. Roasting generally takes about 3-5 minutes and the drum is rotated by hand during this period. The roasted nuts, which are still burning, are covered with ash to absorb the oil on the surface. The shell becomes brittle and rate of shelling and the outturn of whole kernels reported to be highest among the three methods of roasting.

- **Oil bath roasting:**
  Though it is an outdated method in India, majority of Brazil and African countries still follows this system. The roasting equipment consists of a rectangular vessel, 2-3 feet wide and 3 feet deep, with a flat bottom. The whole assembly is embedded in brickwork furnace which uses spent cashew shell as fuel. In this method, raw nuts are passed through a bath of heated CNSL maintained at a temperature of approximately 190-200°C by means of screw or belt conveyor for 1-3 minutes.

- **Steam boiling:** This method is adopted in the factories where hand and leg operated shelling machines are used. The nuts after conditioning are given a mild roasting in an equipment for 20-25 minutes at 5.6-7.0 kg cm^{-2} . This process helps to loosen the kernel and make its removal easy.

Shelling:

- **Manual:**
  Nuts after roasting are shelled (decortication) manually in most of the units in Kerala and Tamil Nadu. Manual shelling is an operation requiring some amount of dexterity. Nuts are knocked 2-3 times on each of the long edge of a wooden mallet or light hammers taking care to see that the whole kernels are released without damage or breakage as far as possible. The outturn will be 90 % of whole kernels. Individual workers' output is about 15-20 kg per 8 h of working day. Workers smear ash or clay on their hands to avoid contact of corrosive shell oil with the skin.

- **Mechanical:**
  The mechanical shelling gadget consists of two blades, between which the raw nut is inserted. The gap is adjustable and therefore it will be advantageous if the raw nuts are pre-graded on the basis of size. By means of lever operated by leg, the blades are brought together which will cut the shell without damaging the kernel inside. The nut is cut to the depth of the shell and a hand lever is pressed to open the shell into

two parts. The pressure exerted by the foot and hands should be so regulated as to cut only the shell and not the kernel. The kernel is then scooped out by means of sharp needle. The output per worker per 8 hours shift in this method is estimated to be 14-22 kg of kernel. The main disadvantage of this method is while handling the mild roasted kernels the CNSL oil may contaminate it, and varying size of the nuts requires careful manipulation during cutting to avoid injury to the hands.

Kernel Drying:

The kernels after separation from the shells are dried to reduce the moisture and loosen the adhering testa. The most commonly used drier is 'Borma dryer'. Kernels are placed in trays with wire mesh bottom and loaded into metal chambers. Indirect hot air from furnace and blower assembly helps to dry out the kernel moisture. Spent shells from the decortication process are burnt as a source of heat and air temperature ranging from 70-100°C will be prevailing inside the whole chamber. In order to get uniform drying, the position of trays is changed at intervals of 30 min. The normal duration of heating is 8-10 h. The moisture content of the dried samples will be in the range of 2-4 per cent (db).

Peeling:

Peeling is the operation of removal of the testa from the kernels. As the kernels are quite brittle after removal from the dryer they have to be cooled for 24-48 h for moisture absorption. A slight pressure applied through the fingers separates the testa. Sharp bamboo sticks or SS blades are also used to remove the adhering testa. The average peeling capacity is 7-10 kg/head /day.

Grading and conditioning:

Kernels are graded on the basis of specification prescribed by Govt. of India under the export (quality control and inspection) Act 1963, which recognizes 23 different export grades of kernels. The kernels are conditioned before packing in sealed tins. If the kernels are too dried at the time of packing, they are liable to breakage during transport by land and sea. If the moisture exceeds limit of 5 per cent kernels become susceptible to microbial and oxidative spoilage.

Packaging of kernels:

Cashewnuts are subjected to rancidity and very quickly go stale. Therefore packing should have low permeability of oxygen and moisture. Method of packing should involve either vacuum or inert gas inside the packing. At present the bulk of cashewnuts is packed in tin containers weighing 25 lbs. Tins kept on vibrating platforms are filled with kernels through a chute. After filling and weighing the tins are evacuated filled with CO_2 with the help of "VITAPACK" machine and sealed. Introduction of alternative method of flexible packaging (Mould Vacuum Packaging) with nitrogen as inert gas is gradually gaining importance. After securing ISO 9000 and introducing HACCP (Hazard analysis and critical control points), importing countries are following stringent quality standards for cashew kernels and the present system of tin packaging is bulky and difficult to dispose off these tin containers.

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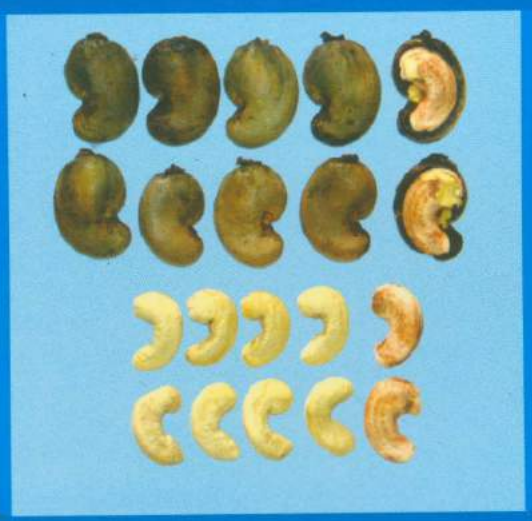
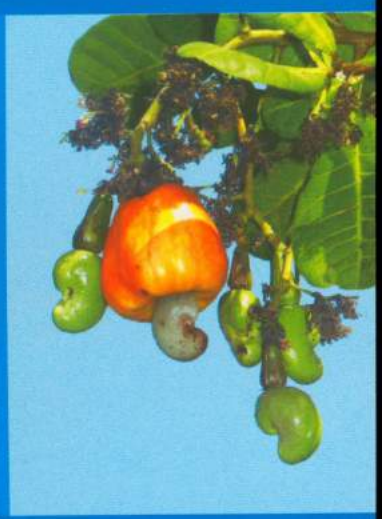
Technical Bulletin No. 21

TECHNIQUES AND PRACTICES FOR CASHEW PRODUCTION

A.R. Desai, S.P. Singh,
J.R. Faleiro, M. Thangam,
S. Priya Devi, S.A. Safeena
and N.P. Singh





Indian Council of Agricultural Research
ICAR Research Complex For Goa
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FOREWORD

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Portuguese introduced cashew into India on the Arabian sea coasts of pre-independent Goa during 16th century. Presently, it is being cultivated in coastal states on both Eastern and Western Coasts and also in non-traditional areas like plains of Karnataka, Chattisgarh, and in Tripura, Meghalaya, Assam and Manipur of North Eastern Hill Region of the country. This crop is earning about Rs.2500 crorers of foreign exchange annually. From the time its introduction, cashew has become important crop of the state entwined in the traditional fabric of Goans' life style. Now, this crop has become main commercial crop of the state covering an area of about 55000 hectares mainly on hilly and undulated terrains in the state. It is imperative to note that the total raw nut production coming out from this area is inadequate and unable to cater to the needs of the local processing units of the state. to only able to meeting Though the area is steadily increasing, production is fluctuating from year to year due to many factors like changing weather, incidence of pests and disease, poor management practices, poor yielding trees and the like, which need vibrant research and management aspects.

It is evident that, cashew plantations in the state of Goa are indeed a genetic treasure of potential genotypes, since, for a long time, seed propagation was in vogue. It is, therefore, prerogative to emphasize on collection and conservation of vital germplasm resources for the posterity. Aptly, the initial cashew research work in Goa began with this point in view, besides the introduction of HYVs from other research stations for evaluation in Goa. Three decades' research, has culminated in the introduction of improved varieties like Vengurla-4, etc.; selection of two high yielding local varieties (Goa-1, and Tiswadi-3) and standardizing the soft wood grafting , top-working and in situ grafting techniques for improved varieties. Studies have vividly shown that the *in situ* moisture conservation greatly benefit the crop for realizing the higher nut yield. Crop management aspects, however, also need to be addressed in future research programmes that may enable to offer complete crop production technology package to growers. This technical bulletin, "Techniques and Practices for cashew production" can serve as a benchmark document for formulating future research and production strategies and provides the relevant information to researchers and farmers alike. I wish, this Technical Bulletin, will be useful to all those involved in cashew industry in general and Goa in particular. I am delighted to say that the ICAR Research Complex for Goa is releasing few more new varieties of cashew for Goa and is evolving several farmer friendly agro-techniques in the immediate near future which help boost the production and productivity of cashew country.

(A. K. Singh)

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PREFACE

Dietary importance of cashew kernels owing to their unique combinations of nutrient supplements like proteins, carbohydrates, lipids, vitamins and minerals, has brought cashew to the status of international trade crop. As a result of this, India, a monopoly till recently, is facing stiff competition in the international market. Moreover, India needs to double the production and productivity not only to meet the requirements of domestic processing sector but also to maintain the status in international scenario so as to earn foreign exchange earnings.

Cashew is the main commercial plantation crop of Goa which occupies more than 50% of the cultivated area in the state. It is, in fact, quintessential part of social fabric and economic machinery of the state. Though, cashew was introduced over four hundred years ago, till recently, it was grown as waste land crop. Research on cashew was initiated in Goa about three decades ago. It was the time when there was no information about recommended package of practices, improved varieties and propagation techniques available in the state and growers were unaware of the real economic potential of the crop. Then onwards, a lot of information on technology development took place by virtue of concerted research efforts. This Technical Bulletin is compilation of such information about the latest Techniques and Improved Practices for Cashew Production, which will be useful for all those dealing with this crop, right from students to the cashew farmers and policy planers.

In this endeavour, we duly acknowledge with great concern the support and encouragement received from the present and former directors, scientist colleagues and all the cooperation and assistance extended by the Technical and Administrative Staff. Authors copiously acknowledge the facilities and encouragement sought from The Indian Coucil of Agricultural Research, New Delhi.

August, 2010

- Authors

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1 INTRODUCTION

Cashew (*Anacardium occidentale* L.), a member of Anacardiaceae family, is a native of North East Brazil in Latin America. Being an evergreen tree of tropics, this is cultivated in more than 28 countries in tropical region on either side of the equator for its delightful nutritious kernels and apple and cashew nut shell liquid (CNSL).

Cashew kernels are excellent nutritive supplements owing to their unique combination of proteins (21%), fat (4750.%), carbohydrates (18-20%), minerals, vitamins and dietary fibre, and thus, find place from tasty dry nuts, sweet dishes to a range of confectionary products all over the world. While, cashew apples, the pseudo fruits are rich in ascorbic acid (40 390 mg/100 g), sugars, minerals and other anti-oxidants. Theses apples although wasted in huge quantities in other states, are mainly used in Goa for preparation a popular alcoholic beverage called "Feni", a GI registered product. However, apples, are used in limited quantities for preparing concentrated juice, syrup, ready to drink beverage, jam, nectar, frozen pulp, fruit wafers, wine, vinegar, *etc.* CNSL finds extensive use in paints, textile, resin industries and ship building industries and is, thus, considered as an important by product of high trade value.

From the time of its introduction in India on the coasts of Goa in 1570 AD by the Portuguese for soil conservation, cashew has adapted very well to Indian conditions. Cashew as on today, has gained special status in the international scenario as a plantation crop of considerable foreign exchange earner. At present, this crop is cultivated in an area of about 40.97 lakh hectares with an annual estimated global production of 37.20 lakh tonnes of raw nuts (FAO, 2010). Though India is one of the major producers of cashew nut in the world, it imports huge quantity of raw nuts. Brazil, Vietnam, Tanzania, Mozambique, Indonesia, Sri Lanka, Australia and Nigeria are the other countries making significant contribution to the world's cashew production. In India, Kerala, Karnataka, Goa and Maharashtra on West Coast; Tamil Nadu, Andhra Pradesh, Orissa and West Bengal on East coast and Tripura, Meghalaya, Assam and Manipur in the North Eastern Hill Region are the major cashew growing states. Maharashtra leads in production with 2.25 lakh metric tones and productivity of 1500kg/ha., while Andhra Pradesh leads in area (1.82 lakh hectares) with production and productivity of 1.12 lakh MT and 920kg/ha respectively (DCCD, 2008-09). Indigenous cashew production, however, is far inadequate to meet the raw nut.

Requirement (12 lakh MT annually) of the processing industries in the country. Situation is same in respect of Goa state also. In Goa, cashew crop is cultivated in about 55,000 hectares (Figure 1) with an annual raw nut production estimated at 30,000 MT with the productivity level of 700 kg/ha. This production is inadequate to meet the raw nut requirement of processing units located in Goa state too.

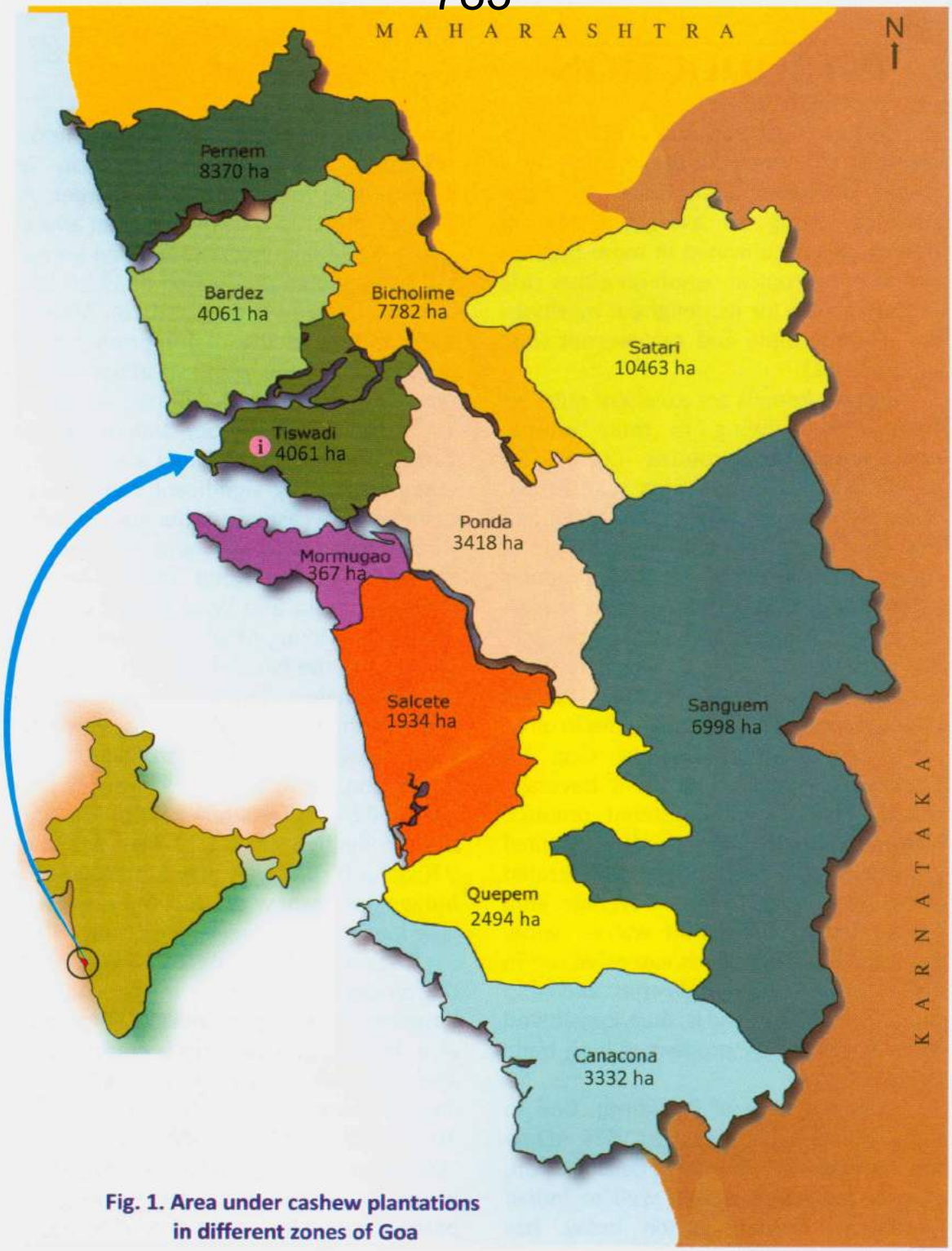


Fig. 1. Area under cashew plantations in different zones of Goa

STATE	2003-04			2004-05			2005-06			2006-07			2007-08			2008-09		
	A	P	APY	A	P	APY	A	P	APY	A	P	APY	A	P	APY	A	P	APY
Kerala	101	95	890	102	64	900	80	67	900	80	72	900	84	78	900	70	75	90
Karnataka	94	46	500	95	43	680	100	45	700	102	52	700	103	56	710	107	60	720
Goa	55	32	690	55	26	660	55	27	690	55	29	690	55	31	700	55	30	700
Maharashtra	148	120	1100	160	174	1200	160	183	1300	164	197	1500	167	210	1500	170	225	1500
Tamil Nadu	95	51	600	105	53	610	121	56	640	123	60	670	123	65	700	131	68	710
Andhra Pradesh	136	95	750	150	88	840	170	92	880	171	99	890	171	107	900	182	112	920
Orissa	124	71	850	126	74	810	120	78	860	125	84	860	131	90	860	137	95	865
West Bengal	9	9	760	9	8	800	10	10	950	10	10	1000	10	10	1000	11	11	1000
Gujarat	-	-	-	-	-	-	4	4	900	4	4	900	4	4	1000	6	4	700
NE States	-	-	-	-	-	-	14	10	640	15	11	700	15	12	750	16	12	750
Others	18	16	790	18	14	800	3	1	400	5	2	500	5	2	500	8	3	460
TOTAL	780	535	800	820	544	810	837	573	815	854	620	820	868	665	860	893	695	900

Source : DCCD, Cochin

A - Area in '000 Ha.
P - Production in '000 MT.
APY - Average Productivity in Kg per Hectare

2

CLIMATE AND SOIL

Although an introduction from Brazil in South America, because of its adaptive ability in wide range of agro climatic conditions, cashew is cultivated in varied climates and soil types in different parts in India. Hot humid tropical conditions in summer with day temperature of 30-38 °C and relative humidity of more than 50 per cent are congenial for its cultivation. It comes up well up to an altitude of 700m from msl.

Goa receives annual rainfall of 2800-3200 mm, confined to the short period of four months from June September. Due to this unimodal pattern of rainfall resulting in long dry spell, especially during the critical period of flowering and fruit set, cashew suffers from severe physiological stress in the lateritic soils of Goa.

Cashew can be cultivated in almost all types of soils ranging from coastal sandy and red lateritic soils to red sandy loam soils in plains and soils with fertility status. It is largely believed that cashew is waste-land crop and does not need much care, as a result of which it is given least attention. This mind-set needs to be changed. It grows well and performs better in well drained red sandy loams with pH in the range of 5.8 to 6.8. Acidic soils below this pH need to be ameliorated with proper soil amelioration practices. Solis with poor drainage and water logging problems with excessive alkalinity and salinity are not suitable for cultivation of cashew and hence may be avoided for commercial orchards.

Until recent times, cashew was considered as "a waste land crop" and was not given due impetus in crop management, ought to be given for any commercially important crop. Even today, high yielding improved varieties are cultivated under rainfed conditions in neglected marginal land. However, studies have indicated that cashew tremendously responds to irrigation and nutrition management. In Goa, majority cashew plantations find place in hilly, undulated topography and degraded soils with poor water holding capacity and low fertility.

These soils generally vary considerably in depth, texture and physico-chemical properties and fertility due to continuous leaching and therefore need to be replenished with proper nutrient management practices.

3 VARIETIES

At present, more than forty high yielding cashew varieties are available in the country for commercial cultivation in different cashew growing states (Table 1).

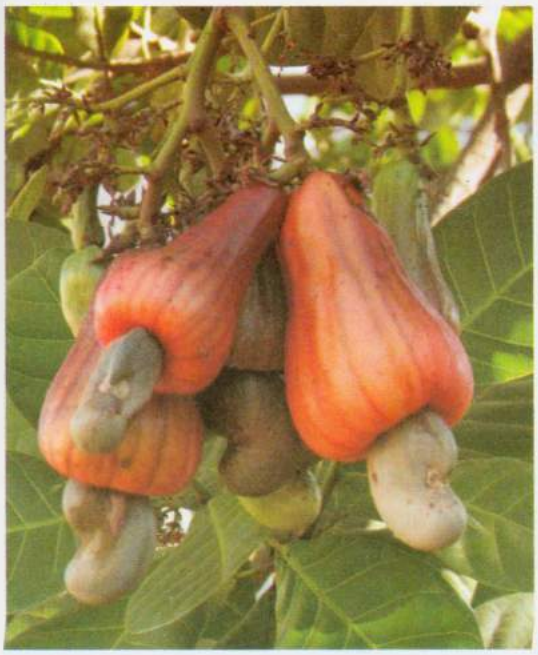
Majority cashew plantations in Goa are of seedling progeny of non- descript types with varied degree of nut and apple yield performance. But, new plantations are coming up with improved high yielding varieties recommended for commercial cultivation in the state of Goa. Following are the suitable varieties for Goa.

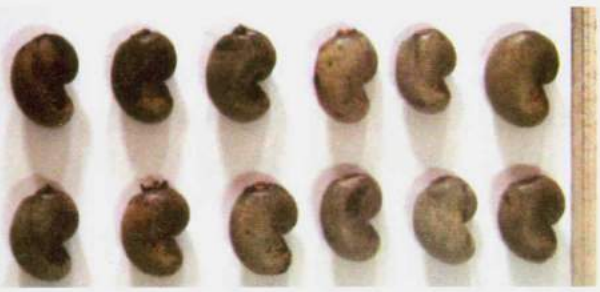
Goa-1(Balli-2): It is a clonal selection from a high yielding plus tree located in Balli village of Quepem Zone of Goa. It is a mid season variety bearing medium nuts (7.6-7.8g) in bunches (Fig. 2). Nuts on processing yield more than 29-31 per cent kernels of W210-W240 grade. Yellow apples are juicy and bigger in size (>70g). This variety yields 9-12 kg of raw nuts per tree at the age 10 years. Because of its mid season bearing nature, it escapes the attack of TMB in the early part of the season (Desai *et al.*, 2001).

Table-1. High yielding cashew varieties suitable for commercial cultivation in different states in the country.

Goa: Goa-1, Vengurla-4, Vengurla7, Vengurla-8, Bhaskara (Goa 11/6)
Maharashtra: Vengurla-1, Vengurla-4, Vengurla-6, Vengurla-7, Vengurla-8
Kerala: Madakkathara-1, Madakkathara-2, Dhana, Kanaka, Dhana,Kanaka, Sulabha, Priyanka, Amrutha, Raghava, Damodara, Poornima and K-22-1
Karnataka : NRCC Sel-2, Ullal-1, Ullal-3, Ullal-4, UN-50, Vengurla, 1, Vengurla-4, Vengurla-6 and Vengurla-7 for coastal Karnataka and Chintamani-1 for Maidan (Plains).
West Bengal: Jhargram-1, and BPP-8
Orissa: Bhubaneshwar-1, BPP-8 and Dhana
Andhra Pradesh: BPP-4, BPP-6, BPP-8
Tamil Nadu: VRI-1,VRI-2, VRI-3
North Eastern Hill Region: Ullal-3, Ullal-4, Vengurla-1 and Vengurla-4

Fig. 2. Goa-1 (Balli-2) Cashew :
Clusters of fruits, nuts, apples and kernels





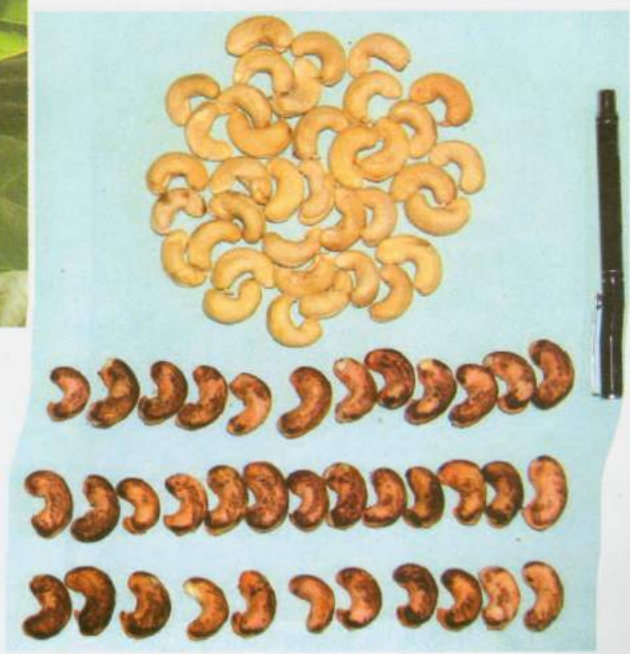


Fig. 3. Cashew apples, nuts and Kernels of Vengurla-4 variety

Vengurla-4: It is an early bearing hybrid variety of the cross : Midnapur Red X Vetore-56. Average nut yield is about 15kg per tree. It yields medium nuts(>7.5g) and red apples are of medium size.

Vengurla-7: It is a hybrid variety of the cross Vengurla-3 X M 10/4. Nuts are bold and yellow coloured apples are medium in size.

Vengurla-8: It is hybrid variety of the cross Vengurla-4 X M10/4. Nuts are medium bold and apples are yellow and medium sized.

Bhaskara (Goa 11/6): It is a clonal selection from a mother tree for higher nut yield (10-12 kg/tree) and tolerance to tea mosquito bug, located in Gaondongrim village, Cancona taluka of Goa. Nuts are of medium size (7.4g) with 30 per cent of shelling (Fig. 4).

Fig. 4. Bhaskara variety

Studies have indicated that new selections namely Tiswadi - 3, KN 2/98 and GNJ - 2 also could be promising new varieties for Goa.

Fig. 5. Tiswadi - 3

Fig. 6. KN 2/98

Fig. 7. GNJ - 2

3 PROPAGATION

Cashew is propagated by both seeds and also by vegetative methods. Seed propagation results in enormous variability in the seedling progeny. Therefore, high yielding cashew varieties are commercially propagated by different vegetative methods to produce true to type planting material, which are described below.

A. Soft wood grafting: This is the most popular and the best method for commercial multiplication of improved cashew varieties and found to be suitable for propagation almost round the year. However, higher success rate of grafting can be achieved during June to October due to abundance of mature scion shoots, favourable temperature and higher relative humidity conditions. Various steps of softwood grafting technique are:

A. 1. Raising of root stock:

- Potting mixture in the proportion of 1part of red soil : 1 part of river sand : 1 part of Farm yard manure/compost has to be prepared with rock phosphate (40-50g/10kg mixture) added to it. This is filled in high density polythene bags of 25cm X 15cm size having thickness of 250-300 gauge, with holes punched on them for proper drainage for raising the root stock seedlings.
- Healthy and fully matured uniform sized seeds should be collected from the peak time in the season, preferably from a single variety and sun-dried for 2-3 days. Such selected seeds can be stored for about 6-8 months in gunny bags or plastic bags which can be further used for raising the root stocks. Such bags should be store in dry and cool place free from rodents.
- Heavy seeds screened by removing the seeds floating in water should be used for sowing. Such seeds, pre soaked overnight have to dibbled with stalk-end upwards, 3-4 cm deep in the centre of the polythene bags filled with potting mixture and watered immediately. Seeds can be sown in fortnightly batches to ensure the availability of root stock seedlings continuously for grafting. Seeds, pre-germinated in moist sand bed, can also be used for sowing to ensure the seedling in each polythene bag filled with growth medium.
- Watering should be done depending on the seasonal requirements (daily in summer) to ensue the proper germination which takes about 2-3 weeks. Healthy seedlings of 7-8 weeks old (50-60 days) after germination, are used for soft wood grafting. Collar rot or damping off disease during rainy season can be controlled by spraying Bordeaux mixture (1%) or Bavistin (1%) at fortnightly interval. Sucking

Fig. 8. Raising of root stock

A - Germination of seeds in sand bed
B - Sowing of pre-germinated seeds in poly bags
C - Uniform growth of seedlings
D - Healthy seedlings becoming ready for root stock

Pre-curing of scion shoots

Collection of scion sticks

Preparation of scion sticks

Selection and preparation of root stock

Fig. 9. Preparation of scions for soft wood grafting

pests like Tea Mosquito Bug (TMB) and Thrips can be controlled by spraying Monocrotophos or Quinolphos (1.5 ml/litre of water) during the growth of seedlings.

A. 2. Preparation and Collection of scion sticks: In the scion bank, healthy, non-flowering matured shoots of 4-5 months of current growth on desired variety are to be selected and precured by clipping off the leaves with part of petiole retained on the shoot, with help of a Secateur (Fig. 9). Precuring should be done, batch wise at fortnightly interval, 10-12 days prior to grafting in order to stimulate the dormant buds on the shoots which will ensure the higher rate of graft take. Such pre-cured shoots of 15-20 cm length (scion sticks)which will be having bulged buds are to be collected early in the morning on the day of grafting.

A. 3. Tieing the graft:

- Healthy root stock seedlings of 7- 8 weeks old (50-60 days) are selected for grafting. On the root stock seedling, very tender portion of terminal shoot is nipped off and all the lateral leaves except the lower most two pairs, are removed using the grafting knife. A transverse downward cut is given in the soft wood portion on the decapitated stem (15-20cm above) to make a cleft of 5-6 cm deep. From the inner portion of cleft lips at the top, some portion of wood has to be removed to ensure smooth union at the grafting joint without any dead wood.
- From the scions collected, a scion stick matching to the clefted root stock is selected and cut freshly at the bottom to reduce it to required length (10cm) and sharpened to wedge shape by giving smooth inward slant cuts at one stroke longitudinally downwards (up to 5-6 cm) on opposite sides on the scion stick so that the bark portion is intact on the other sides.
- The wedge shaped scion stick is inserted in to the cleft of the root stock and the cleft is closed in such a way that the cambial portion of both the scion stick and root stock comes in exact contact and the union portion is fastened firmly with polythene tape (100 gauge). The scion portion on the stock is covered with polythene bag to ensure the humid condition also to overcome the desiccation of the scion. Alternatively, all the grafted plants can be kept under poly house with mist facility to ensure the hot humid conditions required for faster callus growth in the joint region. The plants are maintained under nursery shed for 20-30 days to encourage the sprouting of the potential buds on the scion portion after which the polythene bags are removed and the grafts are shifted to shade-net house (50%) and then to open condition for hardening. Depending on the season, about 70-

Longitudinal cleft in root stocks

Placing of wedged scion in cleft

Tying of graft joint

Grafted plant

Covering of scion with polythene bag

Fig. 10. Preparation of root stock and tieing of graft

90 per cent graft success can be achieved by this method.

A. 4. After care: Polythene strip should be removed after five months to avoid girdling on graft union. The side shoots arising from the root stock region should be removed periodically. Striking of the tap root in to the nursery ground can be prevented by stacking the successful grafts on polythene sheet spread on the nursery ground. This also helps in sorting of the week grafts for special care. Grafts should be watered regularly depending on the season. Fungal diseases on young leaves can be controlled by spraying the Grafts should be sprayed with Bavistin (1%) to mangage fungal diseases on young leaves and with monocrotophos (1.5ml/litre of water) against sucking pests and leaf minor, at 15-20 days interval. Flowering, if any, in the grafts in the nursery should also be removed.

***B. In Situ* Grafting :** In this method of propagation also, softwood grafting technique is employed, but he the entire exercise is carried out in the main field itself instead of the nursery practice. Various steps involved are:

- Lay out the main field and dig-open the pits for curing during May. Fill the pits with top soil mixed Farm yard manure (FYM).
- Plant 2-3 selected seeds in the first week of June, in the centre of each pit filled with soil and FYM to raise the root stocks in the main field.
- Graft the desired pre-cured scion as described in 'soft wood grafting' on 3-4 months old, healthy root stock seedlings during September-October period and cover the scion with plastic cover. Other seedlings can be used if graft take is failed in the first attempt.
- Once the buds are sprouted, remove the plastic bag and remove the plastic strip January or February to avoid girdling. Remove the side shoot on the root stock below the grafting union.

Advantages: Tap root system is intact unlike in field planted grafts, therefore, supports the extensive growth of lateral roots and withstands the onslaught of uprooting by stormy winds.

In situ grafting may induce precocity, because, minimum size of canopy required for first harvesting is achieved in advance of one year.

If root stocks are standardized, this method offers scope for taking advantage of positive stionic effect for specific varieties.

In situ grafting is cost effective.

C. Top working: This is a technique exclusively for rejuvenating / converting the unproductive cashew trees into trees of high yielding varieties. Poor yielding young trees of 5-20 years age can be top worked with desired high yielding variety. This technique involves the following steps:

Fig. 11 . *In Situ* grafting :

A - Germinating seeds in pit in the main field
B - Seedlings ready for *in situ* grafting after 4 - 5 months
C - Healthy *in situ* soft wood graft
D - Canopy growth of *in situ* graft

- Selection of trees. Poor yielding trees from existing plantations have to be identified for top working.
- Beheading: The selected tree have to beheaded to a height of 0.75-1.0m from the ground level with the help of saw to overcome the cracking or splitting at the cut ends. Beheading has to done during may-August.
- Spray the cut ends with Chlorpyriphos (0.5%) and apply Bordeaux Paste(10%) immediately to overcome the attack of cashew stem and root borer.
- Lateral buds from the sides the beheaded branches start sprouting within a month resulting in lot of new shoots which need to be protected from the attack of tea mosquito bug and other insects.
- Grafting: Scions of the desired high yielding varieties have to be wedge-grafted on the soft wood region of the young shoots sprouted from the sides of the cut branches. Grafting has to be done on 10-15 healthy shoots of 30-45 days growth during August-October. Other shoots should be thinned out to encourage the graft take.
- Side shoots arising from the portion below the graft union should be regularly removed.

  In successfully top-worked trees, growth of canopy would be very fast because of the advantage of its well established root system and the trees start yielding right from second year itself.

D. Air layering: This is the earlier method which was being followed before the soft wood grafting was standardized in cashew. In this method, the mature shoots on the tree are girdled and the girdled region is fastened with moist growth medium to facilitate the rooting at the girdled region. Once sufficient rooting is observed after three months, the shoots with roots are cut from the tree for using as true to type planting material. This method has become obsolete now for cashew.

5

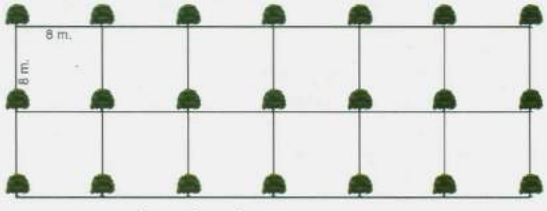
PREPARATION OF LAND AND PLANTING

For establishing new orchards, the land has to be cleared off thorny bushes, shrubs and other weeds well before the pre-monsoon showers (April May).

5.1 Planting Systems for lay out: Selection of appropriate planting system based on the topography of the land, fertility and type of soil is very important for establishing cashew plantations in different locations. Generally, Square, Rectangular and Triangular System of planting are recommended for cashew plantations.

1.Square system: Spacing between rows and columns of trees is same. Spacing of each tree in all the four directions is same. Recommended spacing s are : 8m X 8m for highly fertile soils, 7m X 7m for medium and light soils and 5m X 5m (high density planting) for sandy or poor or very light soils

Type of soil	Spacing	No. trees/ha.
Fertile soils	8m X 8m	156
Medium and light soils, Red laterite soils	7m X 7m	204
Poor/ sandy/ lighter soils	5m X 5m (High Density)	400



Sketch of square system

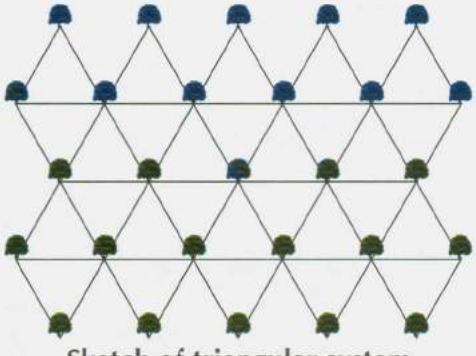
2. Rectangular System: Spacing between rows and columns of trees is different depending on the purpose and topography of the land.

Type of soil	Spacing	No. trees/ha.
Fertile soils	9m X 7m	158
Medium and light soils, Red laterite soils	8m X 6m	208
Poor/ sandy/ lighter soils	5.5m X4.5m (High Density)	404

Sketch of rectangular system

3.Triangular System: In this system, the spacing of all the trees will be equidistant in six directions and three trees are arranged in triangular manner. This accommodates 15 % more population compared to square or rectangular system.

Type of soil	Spacing	No. trees/ha.
Fertile soils	8m X 8m	180
Medium and light soils, Red laterite soils	7m X 7m	234
Poor/ sandy/ lighter soils	5.25m X525m (High Density)	416



Sketch of triangular system

Lay out the field in appropriate system with peg marking at recommended spacing to facilitate digging of pits.

5.2 Opening of pits: Pits of the size of 60 cm X 60 cm X 60 cm at the required spacing depending on the planting system can be opened manually. Circular pits of 60cm (24") diameter with 60 cm depth can be opened mechanically also by tractor mounted post hole digger. Leave the pits open for about 15-20 days for curing.

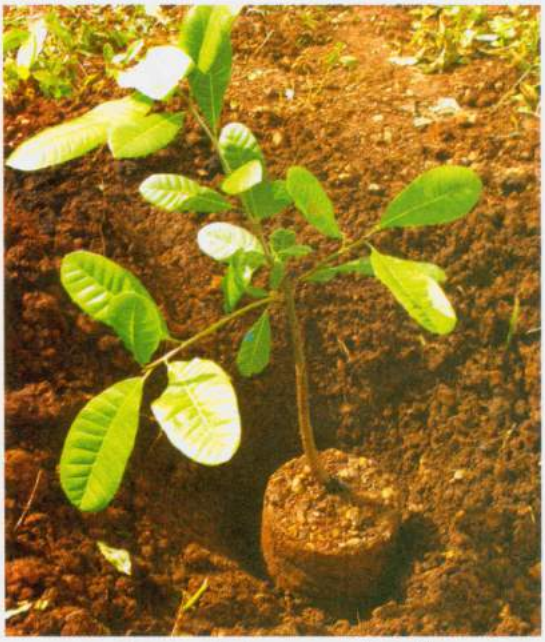
5.3 Planting material and method of planting:

Healthy, 10-12 months old soft wood grafts of improved high yielding varieties should be used for planting. After pre-curing, fill pits completely with top soil mixed thoroughly with one basket (15-20 kg) of compost or Farm Yard Manure, 300-400 g massoriephos or rock phosphate and 100 g of anti termite pesticide. For planting, scoop out a spadeful of top soil from the centre of the pit. Graft has to be placed in the pit in such a way that graft joint is 5 cm. above the ground level. Support the graft with appropriate staking by tieing loosely with gunny thread.

5.4 Time of planting: Immediately after the onset of monsoon, plant the graft in the center of each pit and support it with appropriate staking. Mulching the basin with green leaves helps establishment of the grafts. The most ideal time for planting of cashew grafts is second fortnight of June to July. Planting during this period ensures better establishment of grafts in the field. In case of *in situ* grafting, planting of selected seed nuts has to be done in the centre of pits, as described earlier, in the first week of June just after the on-set of monsoon.

Sun-cured pit ready for taking up planting

Removal of polythene bag before planting



Graft with intact earth ball placed in centre of the pit

Support of staking for graft

Fig. 12 Method of planting graft

6 HIGH DENSITY PLANTING

In order to use the land intensively for realising higher productivity per unit area, especially in the early phase of the plantation and also to achieve the higher economic returns in the early phase, high desity planting techniques can be adopted (Salam, 1997). This also can be followed where the soil fertility is poor for which the canopy expansion will not fast. This method involves planting of more number of grafts per unit area as compared to that of normal density of 200 number of grafts at 7m X 7m spacing. In order to achieve higher density, grafts are planted at 4mx4m, 5mx5m or 8mx4m for the planting density of 625, 400 or 312 per hectare, considering the suitability, purpose and need. Depending on the type land, higher density population is retained for the initial period 7-10 years. This actually is based on the rate at which the canopy is expanding in orchard conditions. In poor soils, rate of growth will rather slow and hence population density can be maintained for longer period till the cnopies of the adjoining trees touch with one another. On the other hand, in fertile soils canopy expansion will be faster indicating the early thinning of population to overcome competition among the trees for soil moisture, nutrients and light. Finally, at full growth stage, population is reduced to normal density of 200 trees by thinning down the population periodically.

This is a specialized technique, which needs intensive management of nutrient supply, canopy pruning and irrigation practices with view to maintain sustainability in the long run. Studies have indicated that cashew yield can be increase to three to four folds in the initial phase up to 6-7 years which would further decline gradually up to two fold at 12th year in a plantation with density of 312 to 625 trees per hectare as compared to plantation of normal density of 200 trees per hectare (Venkattakumar et al,2003 Jose Mathew and Mini, 2008). This system also overcomes exposure of ground to the sunlight , especially in the peak summer and thereby decreasing the soil moisture evaporation. Heavy deposit of leaf biomass on the ground also conserves moisture and also adds in situ-recycled nutrients to the soil. There will also be reduced under canopy weed growth. Due to pruning and thinning , substantial quantities of fire wood can be obtained. One should be careful regarding the incidence of cashew stem and root borer and its integrated management while resorting to the pruning or thinning of trees.

7 MANURES AND FERTILIZERS

Most of the cashew growing areas in the country including that Goa state are poor soil fertility and water holding capacity. But, the studies have indicated that Cashew responds well to application of manures and fertilizers. The standard recommended dose and schedule of application for cashew trees of different age groups are as given in table 2.

7.1. Method of Applying: Entire quantity of manure or compost and half of the recommended dose can be applied in the first fortnight of June and remaining half in August-September. Fertilizer has to be applied in a circular ring within a radius of 22.5 m around the tree trunk at a depth of 15 cm and covered with green leaves and soil. In hill plantations to avoid leaching, entire dose can be applied once in August. Problematic soils (reclaimed mine rejects of Goa) need to be tested. Special care needs to be given while recommending for High density plantations to avoid excess application per unit area.

7.2 Management of soil pH: Most of cashew growing coastal areas being high rainfall areas, generally soils are lateritic and acidic in nature. Since very low pH conditions are not conducive for better performance of cashew, such soils, observed, particularly in Goa, can be ameliorated by application of 5-10 kg of lime or dolomite per tree once in two to three years. This practice facilitates the availability and uptake of nutrients especially phosphorous, calcium, magnesium and micronutrients like molybdenum by the trees.

Of late, customized speciality fertilizers are coming into the markets in a big way. These are specific to the crops and location. Such speciality fertilizers for cashew crop would be of utmost importance from precision farming point of view in order to avoid under or over- use of fertilizers. These are also taking care of the requirement of cashew trees for micronutrients, which otherwise, are hardly given attention in commercial cultivation of cashew crop.

Organic cashew : Supplementing nutrients through organic sources like oil cakes, green leaf compost, vermicompost, fish meal, bone meal, FYM and Poultry / pig manure, spray of EMO, etc is a common practice for production of cashew organically. One should be careful while using oil cakes like neem cakes, as such cakes will cause the increase in soil acidity as a result of which multiple problems crop up in cashew plantations.

Table. 2. Recommended dose of manures and fertilizers

Age		Nutrients (g /tree/year)			Fertilizers (g /tree/year)		
	Compost / FYM (kg)	N	P_2O_5	K_2O	Urea	Rock phosphate	Muriate of potash
1	15	250	50	50	250	175	85
2	30	500	100	100	500	350	165
3	40	750	200	200	1000	750	330
4th yr & onwards	50 kg	1000	300	400	2000	1500	660

8 INTERCROPPING

During the initial period of cashew plantations, several intercrops can be taken up in the inter-space up to first three-four years. Considering the terrain of the land under agro-climatic conditions of Goa, high value crops such as turmeric, ginger, groundnut, vegetables like bhendi, cucurbits, chillies and fruit crops like pine-apple, papaya can be taken up. This practice not only provides considerable income from intercrops, even will have complementary beneficial effects on cashew grafts during the initial period of growth and development, besides providing employment opportunities, during the gestation period.

Studies have indicated that turmeric varieties such as Sudarshan, Prabha, Pratibha, Kedaram, Alleppey and RCT-1, and ginger variety- Varada can be successfully cultivated as intercrops in cashew plantations during gestation period with rhizome yield of 10 12.5 tonnes per hectare to realize a net profit of Rs 50,000 from one hectare area. Similarly, Confectionary type of groundnut varieties like Asha and TPG-40 can also be successfully cultivated as intercrop in cashew plantations for considerable income.

For planting of Pineapple trenches of 1m width and convenient length should be opened across the slope in the interspace. Pineapple suckers are planted in paired rows, 60cm apart with 30cm spacing between plants , in zig zag manner. Improved varieties like Queen, Gaint Kew and Mauritius can be taken up. About 15 tonnes/ha of fruit yield can be harvested from the interspace. Drumstick (which can serve as trap crop against TMB) with proper pruning can also be taken up along the contours.

9 SOIL AND WATER CONSERVATION MEASURES

Continuous contour trenches (CCT) of field length or 2m long Staggered contour trenches of 45cm top width X 30 cm bottom width X 45 cm depth (SCT) are recommended for *in situ* moisture and soil conservation measures (Manivannan, 2003). This practice will greatly support the establishment of grafts in the main field and also the grown up trees especially during dry period coinciding with flowering and fruit setting period. Studies on young cashew trees of 7 years old plantations at our institute indicated that such practices would enhance physiological efficiency of the trees and thereby increase the yield by more than 50 per cent (Desai, 2008).

Fig. 13. Inter cropping in cashew : A - Turmeric, B - Ginger, C - Elephant foot yam

10

TRAINING AND PRUNING

During the initial stage of orchard establishment, shoots arising on the rootstock have to be regularly removed to promote better scion growth, particularly in the first year after planting, which otherwise could result in scion rejection thereby leading to the field mortality of grafts. Since cashew trees tend to spread their canopies and lodge easily, proper staking is also essential. Training of young trees during the first three years is essential to develop uniform canopies. Training in the juvenile phase basically comprises of removing basal branches and water shoots. The plants are trained to a single stem and branches are allowed to grow about 0.75-1m from ground level. Deformed branches are also removed during the first few years. Trees are kept under check by topping off the main stem at a height of 4-5m from ground level. Orchard operations such as terracing, weeding, fertilizer application, nut collection and stem/root borer infestation control can be easily achieved if trees are properly trained.

Pruning should be carried out in August-September at least once in three years in order to remove the crisscrossing branches and unwanted growth for providing the incidence of adequate sunlight into the canopy. Since fruiting is only encouraged from the third year, de-blossoming has to be carried out as flower clusters appear during the initial phase of growth. Dead branches and branches with die-back symptoms should also be pruned periodically. Depending on the growth habit of the trees of different cashew varieties, the canopies of the neighbouring trees will start touching each other after 7-10 years of age. Regular, light pruning of the branches all around the canopy will facilitate the exposure of canopy to sunlight. Studies at Directorate of cashew Research, Puttur, have indicated that pruning enhances flowering and yield in varieties with extensive branching habit, while it will have adverse effect on varieties with intensive branching habit. Yield stabilization can be achieved after 7-8 years of planting. Therefore, pruning should be selective, variety specific and in old trees which have tendency for declined yield (Nayak, 2007).

Limb pruning technique can be used as a good tool to rejuvenate unproductive plantations of improved varieties /hybrids of cashew Trees of more 15years,which cover entire inter and intra space and show decline in yield or fail to give yield (Rajanna and Nayak, 2007). This technique involves cutting of the primary branches at 2 ½ -3 feet from the main trunk during August-September so that, new sprouts commence in the next month which subsequently flower and fruit in January-February. Pruning has to be done by using a saw to achieve a perfect cut end without any cracks or damage to the bark of the branch. This technique has given successful results for cashew trees cultivated in fertile soils of planes in Karnataka.

11

PLANT PROTECTION

On cashew, major insect pests are Tea mosquito bug (*Helopeltis antonii* S.) and Cashew stem and root borer (*Plocaederus ferruginneus* L.), besides which other insects like leaf and flower webber, thrips, leaf minor and mealy bugs, considered as minor pests, are also causing economic loss in cashew crop of late.

11.1. Tea mosquito bug (TMB) : Incidence of Tea mosquito bug on cashew occurs at new flushing, flowering and fruiting stages during September to April and causes crop losses ranging from 20-60 per cent. The damage is caused by adult bugs as well as by immature stages (nymphs) which suck the plant sap from the tender flushes and succulent shoots, flower panicles, growing nuts and apples.

Symptoms: Closer observation reveals the occurrence of dark brown patches on green tender stem of young shoots and inflorescence rachis. Severe incidence leads to flower blight and drying of young shoots and flower panicles. Attack on tender nuts and apples causes shriveling of developing nuts leading to immature fruit drop. The affected trees will conspicuously have the dried leaves on dead tender shoots and dried inflorescences on tree canopy which can be prominently seen from a distance. Severely affected branches may lead to the secondary infection by fungus *Botrydiplodia theobromae*) causing 'die back' disease, i.e drying of branches from tip and extending downwards. Such branches will have the brown discolouration in the sap wood extending towards lower portion.

Integrated Management: This pest can be effectively managed by spraying the trees in three critical stages.

1. Establish the cashew plantation by planting 2-3 high yielding varieties with varied degrees of tolerance or escape mechanism so that the impact of pest incidence will be reduced due to varied degree of pest host reaction.
2. Spray the tree canopy at flushing stage with monocrotophos at the rate of 1.5 ml/ litre of water (0.05%) or with Lambda-cyhalothrin at the rate of (0.003%)
3. Spray carbaryl (50% WP) at the rate of 2g/litre of water (0.1%) or chlorpyriphos (0.05%) at flowering stage
4. Repeat the 'first spray' at initial fruiting stage.
5. Cut the 'die back' affected branches up to the healthy region and apply the cut end with Bordeaux paste (10%) and spray the tree with 1 per cent Bordeaux mixture solution.
6. Arrest the build- up of the pest population by maintaining the hygienity in plantation and also care should be taken for controlling the population even on the alternate host trees (drum stick, guava, neem, etc ., if any, in the surroundings.

11.2. Cashew stem and root borer (CSRB): This is the most dreaded pest of cashew trees, the immature stages (grubs) of which feed on the bark of trunk and roots and out rightly kill the tree within few days. Due its concealed nature of damage, it is difficult to make out the status or level of damage to the tree and therefore, unlike

TMB, is a threat to the life of the tree. This is a dark brown beetle with long antennae which lays eggs in the crevices of the bark on the collar region.

Symptoms: Incidence of the pest can be made out by the presence of extruded frass (like coarse saw dust powder) on the ground surface at the base of cashew tree trunk. On closer examination, one can see small holes on the collar region through which the frass is pushed out by the insect. After hatching of eggs, the grubs immediately start boring into bark of collar portion and root for feeding on the inner portion of the bark tissues. Further, they bore irregular tunnels throughout. As a result of severe injury to the vascular bundles, gum like substance oozes out and gets deposited on hardening to form dark brown clumps on the affected region. In case of severe infestation , due to continuous feeding on vascular tissues, the trunk becomes internally girdled. At this stage, leaves show yellowing symptoms, start shedding immaturely and subsequently the entire tree dries up within a few days. Affected trees also tilt on one side due to loss of anchorage, if the injury is severe on anchoring roots. Infestation occurs round the year.

Integrated management:

1. Monitor regularly for the presence of the frass near the base of the trunk.

2. Mechanically remove the grubs from infected trees in the initial stage of infestation.

3. inject 0.36 per cent monocrotophos by the padding method.

. Soak / drench the bark of the infested trees with 0.5L of 0.1 per cent chlorpyriphos, one meter above the ground and also by drenching the soil/ root zone in a radius of 0.5m around the stem with 5L of the same insecticide to kill the grubs / pupae in the root zone.

5. Repeat the injection of all infested trees with monocrotophos after 15 -20 days.

6. It is very important to adopt the phytosanitory measures like removal of dead trees infested with CSRB and bury or burn the same to avoid further spread of infestation.

11.3. Minor pests:

Leaf and blossom webber (*Lamida moncusalis* L.): As indicated by its name, this pest attacks the young leaves of new flush and inflorescences. The caterpillars form the web of young leaves and flower panicles and feed on these from inside as a result of which, the webbed shoots totally dry up.

Leaf miner (*Acrocercops syngramma* M.): Larvae of this insect mine through the young leaves of new flushes. In the mined laminal areas the epidermal layer gets separated from the leaf tissues in patches giving white blistered patches.

Apple and nut borer (*Thylocoptila* sp.): The larvae of this pest bore the region of juncture where the nut is attached to apple and start feeding on tissues. The incidence can be conspicuously seen by the presence of frass and excreta of the larvae at the tunneled place.

Mealy bug (*Ferrisia virgata*): Nymphs and adults of mealy bugs suck large amount of sap from the growing shoots, inflorescence and developing fruits. These insects also excrete sugary substance (honeydew) on which sooty mould develops which impairs photosynthetic activity rendering 16-30% losses in nut yield under severe out break conditions.

All these minor pests can be taken care of by the prophylactic sprays adopted for the management of tea mosquito bug.

Fig. 14. Tea Mosquito Bug: a serious pest on cashew

A - Adult bug
B - Immature stage (Nymph)
C - Shoot damage

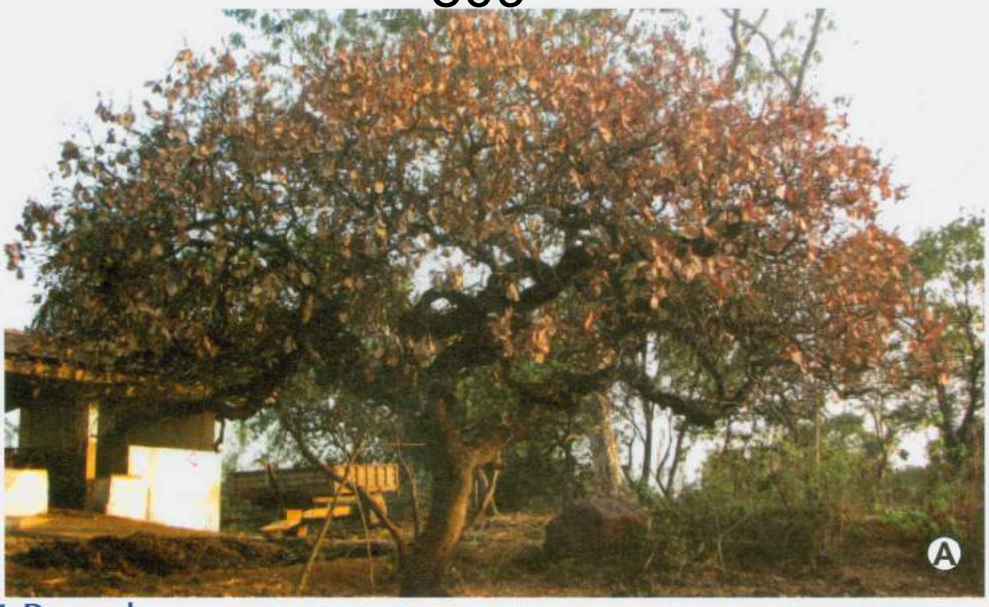


Fig. 15. Damage by cashew stem and root borer

A - Dried tree affected by cashew stem and root borer

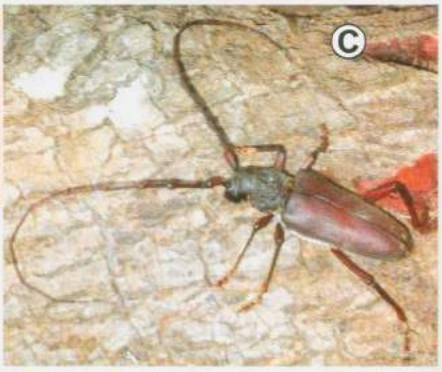
B - Immature stage (Grub) of cashew stem and root borer

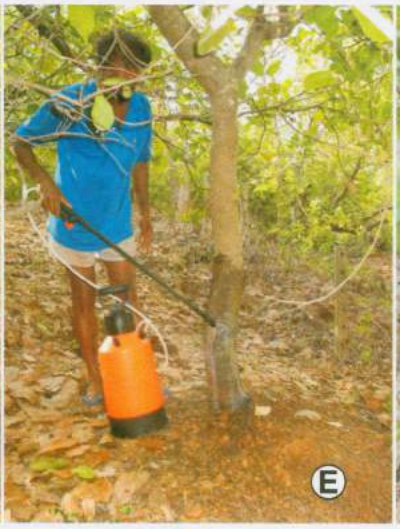
C - Adult of cashew stem and root borer

D - Frass near the affected trunk

E - Drenching of chlorpyriphos on base on the trunk

F - Recovered turnk





12

HARVESTING AND YIELD

It is advisable to take crop from fourth year onwards, before which flowers, if any, may be removed to encourage proper vegetative growth. The harvesting, depending on the varieties, commences from February and continues till May end. In Goa, the dropped fruits with nuts are collected and nuts are separated from the apples. General yield trend of improved varieties is presented below.

About 10 15 kg per tree (2.5 - 3 tonnes/ha) of raw nut yield and about 80 100 kg per tree (1520 tonnes/ ha.) of cashew apple yield may be expected at 10th year and onwards, with adoption of all the production practices on time. Nuts separated from apples are thoroughly sun-dried for 3-4 days and stored in gunny bags for further processing.

Table 3. Expected yield performance

Age of tree	Nut yield (Kg /tree)	Apple yield (Kg/tree)	Yield per ha*. (tonnes)	
			nut	apple
4th year	0.7	5.0	0.15	1.0
5th ,,	1.5	10.0	0.3	2.0
6th ,,	3.0	20.0	0.6	4.0
7th ,,	6.0	40.0	1.2	8.0
8th ,,	8.0	60.0	1.6	10.0
9th ,,	10.0	70.0	2.0	15.0
10th ,,	12 - 15	85.0 - 100.0	2.5-3.0	17.0 -20.0

*200 grafts/ ha (7m X 7m spacing)

13 ECONOMIC RETURNS

For establishing cashew plantation in one hectare area, it requires about Rs 27100.0 for initial investment. But, cashew has a juvenile phase for the initial period 3-4 years. During this period, considering the need and suitability, high value annual crops can be cultivated as intercrops for deriving the income during the juvenile period. Economic yield can be harvested from fourth year after planting and the breakeven point starts from 6^{th} - 7^{th} year. Details of cost of cultivation and economic returns from cashew plantation of one hectare area for first ten years are presented in Table 4. With all the improved production practices and stabilized yield at 9-10 years , a net return of more than Rs 80 000 may be expected annually from one hectare area under cashew plantation.

Table 4 . Cost of cultivation for establishment of 1 ha of cashew plantation with density of 200 tree/ha (7m X 7m spacing) and economic returns:

Particulars	I yr	II yr	III yr	IV yr	V yr	VI yr	VII yr	VIII yr	IX yr	X yr	Total
Land clearing 30 man days X Rs 200	6000	1000									7000
Digging of 200 pits @ 25	5000										5000
Pit filling, planting , staking & mulching @ Rs. 5	1000	200									1200
Cost of grafts (210 no) @ Rs 25	5000	250									5250
Organic manure @ Rs. 0.5 X 15kg X 200	1500	3000	4000	5000	5000	5000	6000	6000	6000	6000	47500
Chemical fertilzer	600	1200	2000	3000	4000	6000	10500	12000	12000	15000	66300
Plant protection	250	500	750	1000	1250	1500	2000	2250	2500	2500	14500
Labour for fertilizer application	500	750	1200	1600	2000	2000	2000	2000	2000	2000	16050
Labour for Plant protection	250	480	900	1200	1200	1500	1500	1500	1500	1500	11530
Implements	1800					2000					3800
Intercrops (Rs/ha)	4000	4000	3000	2000							13000
Labour(Harvesting) @Rs 2/kg				200	400	1000	2000	3000	4000	5000	15600
Miscellaneous(Rs/ha)	1200	1200	1200	1200	1500	1500	1500	1500	1500	1500	13800

Table 4 Contd...

Total Expenditure	**27100**	**12580**	**13050**	**15200**	**15350**	**20500**	**25500**	**28250**	**29500**	**33500**	**220530**
Cash Flow											
From intercrops	15000	12000	12000	6000	-	-	-	-	-	-	45000
Nut yield(kg/ha)	-	-	-	150	300	600	1200	1600	1800	2000	
Income from nuts(@Rs 50/kg nuts)				7500	15000	30000	60000	80000	90000	100000	490000
Apple yield (kg/ha)	-	-	-	1000	1400	3500	7000	10000	15000	17000	
income from apple @Rs 1/kg apple)				1000	2000	4000	8000	10000	15000	17000	55600
Total gross returns	15000	12000	12000	14500	17000	34000	68000	90000	105000	117000	362600
Net Total Returns (Rs)	-12100	-580	-1050	-700	1650	13500	42500	61750	75500	83500	159270
Net return per tree(Rs)					6.75	67.5	212.0	308.75	377.5	417.0	

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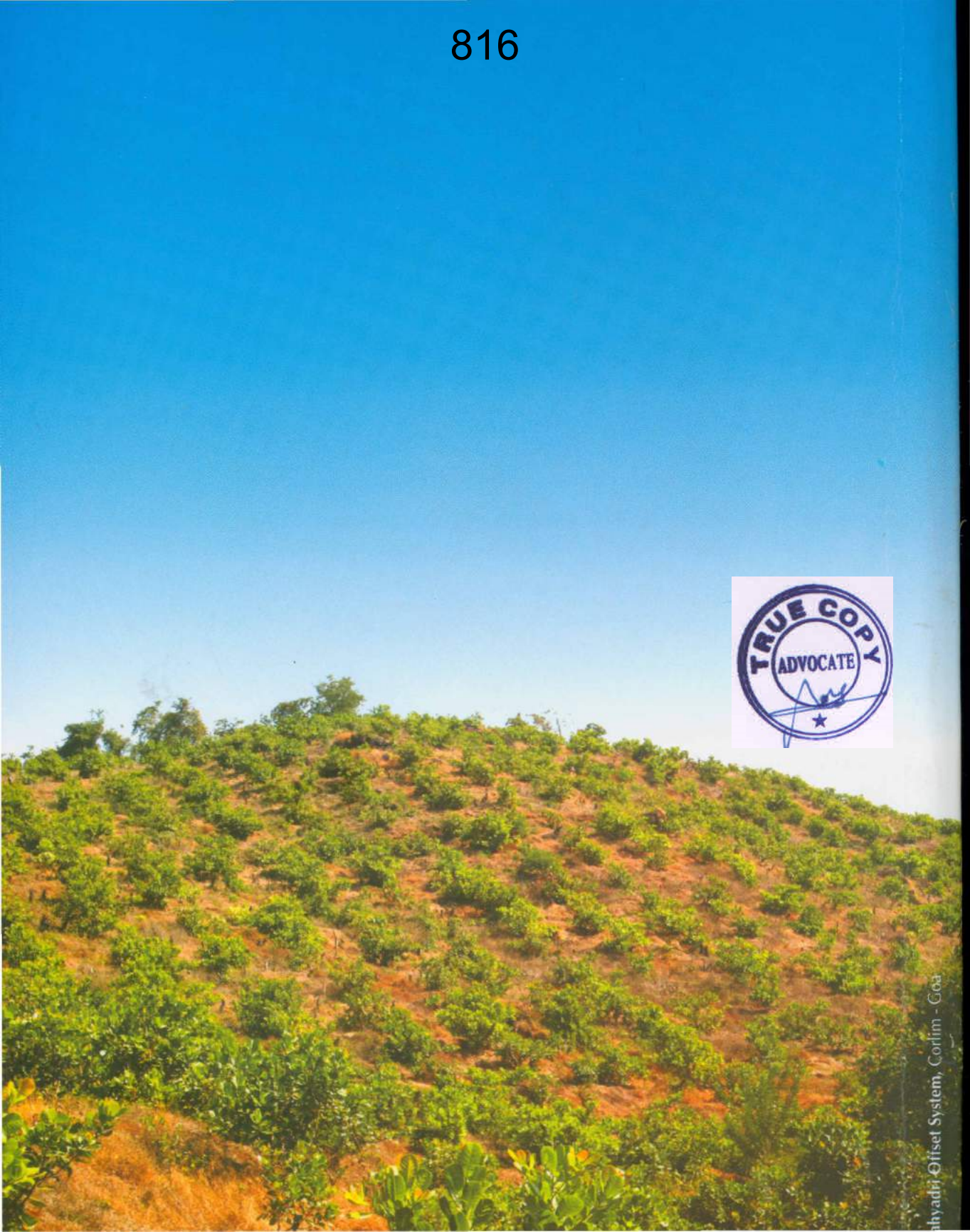


TRUE COPY
ADVOCATE

hyadri Offset System, Corlim - Goa

FOR UNION BANK OF INDIA
M. S. MARG BRANCH
AUTHORISED SIGNATORY

UNION BANK OF INDIA
MUMBAI SAMACHAR MARG BRANCH
PLANNING & DEVELOPMENT DEPARTMENT,
66/80 MUMBAI SAMACHAR MARG,
FORT,MUMBAI-400 023.

D-SSTP(V)C.R.108SI02/2004/2105-07/04

भारत 18671 102300 Special Adhesive महाराष्ट्र FEB 04 2020 10:32
Rs.0000500/-PB5062
INDIA STAMP DUTY MAHARASHTRA

From,
Bank of Baroda,
Mumbai Main Office Branch,
10/12, Mumbai Samachar Marg,
Fort, Mumbai, Maharashtra, 400 001

ANNEXURE-R-18

To,
The Regional Controller of Mines,
Indian Bureau of Mines,
Goa Region, Opp. Old RTO Office,
P.O. Fatorda, Margoa Goa 403602

Bank Guarantee and Co-Acceptance Bond
Extension No. 1
of our Bank Guarantee No. 0381IGPER023918
Dated 05/11/2018 for Rs. 1,40,84,500/-

Bank of Baroda MMO Fort, Mumbai

At the request of M/s Ashapura Minechem Ltd., Jeevan Udyog Building, 3rd floor, 278 D. N. Road, Fort, Mumbai 400 001, we hereby extend the validity of our captioned Bank Guarantee from 01-04-2020 to 31-03-2025.

This extension is the integral part of original bank guarantee and all other terms of the original bank guarantee remain unchanged.

NOTWITHSTANDING ANYTHING CONTAINED HEREIN:

a) Our liability under this Bank guarantee shall not exceed **Rs. 1,40,84,500/- (Rupees One Crore Forty Lakh Eighty Four Thousand Five Hundred Only)**

b) The bank guarantee shall be valid up to 31/03/2025 and

c) The period of bank guarantee submitted is valid for the period of the proposals given in the Modified Mining Plan/ Review of Mining Plan / PMCP etc. We are liable to pay the guarantee amount or any part thereof under this Bank guarantee and only if served upon us a written claim or demand on or before 31/03/2025.

Bank of Baroda MMO Fort, Mumbai

Date: 04 FEB 2020
Place: Mumbai

कृते बैंक ऑफ बड़ौदा
For Bank OF BARODA
(Pratik Thaker)
वरिष्ठ प्रबंधक / Senior Manager-Credit
मुंबई मुख्य कार्यालय / Mumbai Main Office

Fl. no. 124820

कृते बैंक ऑफ बड़ौदा
FOR BANK OF BARODA
(J. Mohapatra)
सहा. महाप्रबंधक/Asstt. Gen. Manager
मुंबई मुख्य कार्यालय/Mumbai Main Office

BANK OF BARODA
Fgn. Credit Dept. / Gttee
Mumbai Main Office,
10/12, M. S. Marg,
Mumbai - 400 001.

FOR UNION BANK OF INDIA
M. S. MARG BRANCH
AUTHORISED SIGNATORY

UNION BANK OF INDIA
MUMBAI SAMACHAR MARG BRANCH
PLANNING & DEVELOPMENT DEPARTMENT,
66/80,MUMBAI SAMACHAR MARG,
FORT,MUMBAI-400 023.
D-SSTP(V)C R.1003/03/2004/2165-67/04

भारत 18672 Special Adhesive महाराष्ट्र
117305 FEB 04 2020
10:32
Rs.0000500/-PB5062
INDIA STAMP DUTY MAHARASHTRA

From,
Bank of Baroda,
Mumbai Main Office Branch,
10/12, Mumbai Samachar Marg,
Fort, Mumbai, Maharashtra, 400 001

To,
The Regional Controller of Mines,
Indian Bureau of Mines,
Goa Region, Opp. Old RTO Office,
P.O. Fatorda, Margoa Goa 403602

Bank Guarantee and Co-Acceptance Bond
Extension No. 1
of our Bank Guarantee No. 0381IGPER008215
Dated 30/04/2015 for Rs. 26,00,000/-

Bank of Baroda MMO Fort, Mumbai

At the request of M/s Ashapura Minechem Ltd., Jeevan Udyog Building, 3rd floor, 278 D. N. Road, Fort, Mumbai 400 001, we hereby extend the validity of our captioned Bank Guarantee from 1-04-2020 to 31-03-2025.

This extension is the integral part of original bank guarantee and all other terms of the original bank guarantee remain unchanged.

NOTWITHSTANDING ANYTHING CONTAINED HEREIN:

Bank of Baroda MMO Fort, Mumbai

a) Our liability under this Bank guarantee shall not exceed **Rs. 26,00,000/- (Rupees Twenty Six Lakh Only)**

b) The bank guarantee shall be valid up to 31/03/2025 and

Bank of Baroda MMO Fort, Mumbai

c) The period of bank guarantee submitted is valid for the period of the proposals given in the Modified Mining Plan/ Review of Mining Plan / PMCP etc. We are liable to pay the guarantee amount or any part thereof under this Bank guarantee and only if served upon us a written claim or demand on or before 31/3/2025

Bank of Baroda MMO Fort, Mumbai

Date: 04 FEB 2020
Place: MUMBAI

कृते बैंक ऑफ बड़ौदा
For Bank OF BARODA
(Pratik Thaker)
वरिष्ठ प्रबंधक / Senior Manager-Credit
मुंबई मुख्य कार्यालय / Mumbai Main Office
EC.no.124820

कृते बैंक ऑफ बड़ौदा
For BANK OF BARODA
(J. Mohapatra)
सहा. महाप्रबंधक/Asstt. Gen. Manager
मुंबई मुख्य कार्यालय/Mumbai Main Office

BANK OF BARODA
Fgn. Credit Dept. / Gtee
Mumbai Main Office,
10/12, M. S. Marg,
Mumbai - 400 001.

FOR UNION BANK OF INDIA
M. S. MARG BRANCH
AUTHORISED SIGNATORY
UNION BANK OF INDIA
MUMBAI SAMACHAR MARG BRANCH
PLANNING & DEVELOPMENT DEPARTMENT
66/20, MUMBAI SAMACHAR MARG,
FORT, MUMBAI-400 023.

भारत 17458 180303 Special Adhesive महाराष्ट्र JAN 30 2020
13:56
Rs0000500/-PB5062
INDIA STAMP DUTY MAHARASHTRA

From,
Bank of Baroda,
Mumbai Main Office Branch,
10/12, Mumbai Samachar Marg,
Fort, Mumbai, Maharashtra, 400 001

To,
The Regional Controller of Mines,
Indian Bureau of Mines,
Goa Region, Opp. Old RTO Office,
P.O. Fatorda, Margoa Goa 403602

BANK GUARANTEE AND CO-ACCEPTANCE BOND

1. Agreement on production of a Bank guarantee for **Rs. 23,91,000/- (Rs. Twenty Three Lakhs Ninety One Thousand only)** under Rule 27 of MCDR, 2017.

2. We, Bank of Baroda, having its Head Office at Baroda Bhavan, R.C dutt road, Alkapuri, Baroda -390007 and Branch Office inter alia at Mumbai Main Office Branch, 10/12, Mumbai Samachar Marg, Fort, Mumbai, Maharashtra, 400 001, at the request of M/s Ashapura Minechem Ltd, Jeevan Udyog Building, 3rd Floor, 278, D. N. Road, Fort, Mumbai 400 001 Maharashtra (Lessee) do hereby undertake to pay to the Regional Controller of Mines, Indian Bureau of Mines Goa Region-Goa or any other officer authority nominated by the Controller General, Indian Bureau of Mines an amount not exceeding **Rs. 23,91,000/- (Rs. Twenty Three Lakhs Ninety One Thousand only)** against any loss or damage caused to or suffered or would be caused to or suffered by the Government or towards noncompliance of provisions of Rule 22, 23, 24 & 26 of MCDR 2017 i.e. Mine Closure Plan/ Progressive Mine Closure Plan approved in respect of the mining lease Rovale Bauxite Mines for Bauxite (ore/ores) over an area of 218.285 hectares granted by State Government to M/s Ashapura Minechem Ltd, Jeevan Udyog Building, 3rd Floor, 278, D. N. Road, Fort, Mumbai 400 001 Maharashtra situated in Village Rovale, Taluka Dapoli, District Ratnagiri in State Maharashtra by reason of any breach of the said lessee of any of the terms or conditions contained in the Mine Closure Plan/ Progressive Mine Closure Plan.

3. We, Bank of Baroda, having its Head Office at Baroda Bhavan, R.C dutt road, Alkapuri, Baroda -390007 and Branch Office inter alia at Mumbai Main Office Branch, 10/12, Mumbai Samachar Marg, Fort, Mumbai, Maharashtra, 400 001 do hereby undertake to pay the amount due and payable under this guarantee without any demur, to the authority merely on a demand from the Regional Controller of Mines, Indian Bureau of Mines Goa Region-Goa or any other authorized by the Controller General, Indian Bureau of Mines stating that the amount claimed is due by way of loss or loss of damage caused to or would be caused to or suffered by the government by reason of breach by the said lessee or any of the terms or conditions contained in the mining plan/ Review of Mining Plan or by reason of lessee's failure to perform the said Mine Closure Plan/ Progressive Mine Closure Plan. However our liability under this guarantee shall be restricted to an amount not exceeding **Rs. 23,91,000/- (Rs. Twenty Three Lakhs Ninety One Thousand only)**

4. We undertake to pay to the authority on a demand from the Regional Controller of Mines, Indian Bureau of Mines Margao-Goa or any other officer authorized by the Controller General, Indian Bureau of Mines or Govt. of India any money so demanded notwithstanding any dispute or disputes raised by the Lessee in any suit or proceedings pending before any court or tribunal relating thereto our liability under this present is absolute and unequivocal. The payment so made by us under this bond shall be valid discharge of our liability for payment there under and lessee shall have no claim against us for making such payment.

BANK OF BARODA ADVANCES GTEE MMO, MUMBAI

BG NO:- 0381IGFIN000720
Date :- 31/01/2020
Valid upto:- 31/03/2025

BANK OF BARODA ADVANCES GTEE MMO, MUMBAI

5. We, Bank of Baroda, having its Head Office at Baroda Bhavan, R.C dutt road, Alkapuri, Baroda -390007 and Branch Office inter alia at Mumbai Main Office Branch, 10/12, Mumbai Samachar Marg, Fort, Mumbai, Maharashtra, 400 001, further agree that the guarantee herein contained shall remain in full force and effect during the period up to the end of the Review of Mining plan period of Five Years that would be taken for performance of the said Agreement and that shall continue to be enforceable till all the dues of the Govt. under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged till Regional Controller of Mines, Indian Bureau of Mines, Margao Goa or any other officer authorized by the Controller General, Indian Bureau of Mines certifies that the terms and conditions of the said Progressive Mine Closure Plan/ Final Mine Closure Plan have been fully and properly carried out by the said lessee and accordingly discharge this guarantee. Unless a demand or claim under this guarantee is made on us in writing on or before 31/03/2025 we shall be discharged from all liability under this guarantee thereafter.

6. We further agree that Regional Controller of Mines, Indian Bureau of Mines, Goa Region-Goa or any other officer authorized by the Controller General, Indian Bureau of Mines shall have fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said lessee from time to time or to postpone for any time or from time to time any powers exercisable by Regional Controller of Mines, Goa Region-Goa against the said lessee and to forbear or enforce any of the terms and conditions relating to the said agreement, we Bank of Baroda shall not be relieved from our liability by reason of any such variation or extension being granted to the said lessee or for any forbearance, act or omission on the part of Regional Controller of Mines, Indian Bureau of Mines, Margao Goa or any indulgence by Regional Controller of Mines, Indian Bureau of Mines, Margao Goa to the said lessee or any manner or thing whatsoever which under the law relating to sureties, would but this provision have effect of so relieving us.

7. This guarantee will not be discharged due to change in constitution of the bank or lessee.

8. We, Bank of Baroda lastly undertake not to revoke this guarantee during its currently except with the previous consent of the Regional Controller of Mines, Indian Bureau of Mines, Margao-Goa in writing.

9. **NOTWITHSTANDING ANYTHING CONTAINED HEREIN:**

   a) Our liability under this Bank guarantee shall not exceed **Rs. 23,91,000/- (Rs. Twenty Three Lakhs Ninety One Thousand only)**

   b) The bank guarantee shall be valid up to **31/03/2025** and

   c) The period of bank guarantee submitted is valid for the period of the proposals given in the Modified Mining Plan/ Review of Mining Plan / PMCP etc. We are liable to pay the guarantee amount or any part thereof under this Bank guarantee and only if served upon us a written claim or demand on or before **31/03/2025**.

10. If the bank guarantee is to be en-cashed through the court, in that case the Indian Bureau of Mines, Fatorda, Margao - Goa court will have jurisdiction.

11. In witness whereof, the bank through its authorized officer has set its hand and stamp on this 31st Day of January 2020 at MUMBAI.

BANK OF BARODA ADVANCES DEPT. MMO, MUMBAI

कृते बैंक ऑफ बड़ौदा
For Bank OF BARODA

(Pratik Thaker)
वरिष्ठ प्रबंधक / Senior Manager-Credit
मुंबई मुख्य कार्यालय / Mumbai Main Office

कृते बैंक ऑफ बड़ौदा
For BANK OF BARODA

(J. Mohapatra)
सहा. महाप्रबंधक/Asstt. Gen. Manager
मुंबई मुख्य कार्यालय/Mumbai Main Office

EC no. 12820

BANK OF BARODA
Fgn. Credit Dept. / Gtte
Mumbai Main Office.
10/12, M. S. Marg,
Mumbai - 400 001.

BANK OF BARODA ADVANCES DEPT. MMO, MUMBAI

B.G. No. 0381GFIN000720
Date: 31/01/2020.
Valid upto: 31/3/2025

बैंक ऑफ़ बड़ौदा
Bank of Baroda

Advice of Issuance of IGFIN-Inland Financial Guarantee

Date: 13/02/2023

To:
ASHAPURA MINECHEM LTD
JEEVAN UDYOG BLDG 3RD FL 278 D N RO
AD FORT
MUMBAI
MAHARASHTRA
INDIA
400001

WE HAVE ISSUED FOLLOWING BANK GUARANTEE AS PER YOUR INSTRUCTION:

BG NO:	0381IGF000449723 - ISS001
BG AMOUNT:	12,717,000.00 INR
TOTAL LIABILITY	12,717,000.00 INR
BENEFICIARY	THE REGIONAL CONTROLLER OF MINES,
ISSUE DATE	13/02/2023
EXPIRY DATE	31/03/2025
CLAIM DATE	30/09/2025

CHARGES DETAILS:

CHARGE DETAILS	CURRENCY	CHARGE AMOUNT	GST AMOUNT
SFMS Charges	INR	150.00	27.00
Inland Financial Guarantee Commission	INR	254,340.16	45,781.23

DEBIT ACCOUNT DETAILS:

ACCOUNT NUMBER	DR/CR	AMOUNT(CCY)	AMOUNT IN WORDS
03810200001271	Dr	**300,298.39 INR**	**Three Hundred Thousand Two Hundred and Ninety Eight Indian Rupee and Thirty Nine Paisa**

Bank GSTN: 27AAACB1534F2Z5
Customer GSTN: 27AAACA0957F1ZY

THIS IS A COMPUTER GENERATED ADVICE AND DOES NOT REQUIRE ANY SIGNATURE
THIS IS A TRANSACTION ADVICE AND SHOULD NOT BE TREATED AS A GST INVOICE

महाराष्ट्र MAHARASHTRA ◐ 2022 ◐ BV 720107

प्रधान मुद्रांक कार्यालय, मुंबई
प. मु. वि. क्र. ८०००२०
17 JAN 2023
सक्षम अधिकारी

THIS STAMP PAPER IS AN INTEGRAL PART
of bank Guarantee No. 0381IGF0004497 23
dated 13/02/2023 for Rs. 1,27,17,000/-
Issued on account of Ashapura Minechem Limited

श्रीमती सायली कोळी

BANK OF BARODA ADVANCES GTEE MMO, MUMBAI

FOR BANK OF BARODA
SENIOR MANAGER (CREDIT)

कृते बैंक ऑफ बड़ौदा
For BANK OF BARODA
सहा. महाप्रबंधक / Asstt. Gen. Manager
मुंबई मुख्य कार्यालय / Mumbai Main Office

PHYSICAL ISSUANCE OF BANK GUARANTEE

BG NO **0381IGF000449723**
DATE **13.02.2023**

TO,
THE REGIONAL CONTROLLER OF MINES,
INDIAN BUREAU OF MINES,
GOA REGION, OPP. RTO OFFICE,
P. O. FATORDA, MARGAO, GOA 403602

BANK GUARANTEE AND CO-ACCEPTANCE BOND

1. AGREEMENT ON PRODUCTION OF A BANK GUARANTEE FOR **RS.1,27,17,000/- (RS. ONE CRORE TWENTY-SEVEN LAKH SEVENTEEN THOUSAND ONLY**) UNDER RULE 27 OF MCDR, 2017.

2. WE, **BANK OF BARODA**,A BODY CORPORATE CONSTITUTED UNDER BANKING COMPANIES(ACQUISITION AND TRANSFER OF UNDERTAKINGS)ACT, 1970 HAVING ITS HEAD OFFICE AT **BARODA BHAVAN, R. C. DUTT ROAD, ALKAPURI, BARODA 390007** AND AMONGST THE OTHER BRANCH AT **10/12, MUMBAI SAMACHAR MARG, FORT, MUMBAI 400001**,(HEREINAFTER REFERRED TO AS BANK) AT THE REQUEST OF M/S ASHAPURA MINECHEM LTD, (LESSEE) COMPANY INCORPORATED IN INDIA UNDER THE COMPANIES ACT, 1956 WITH CORPORATE IDENTITY NUMBER (CIN NO. L14108MH1982PLC026396), WHOSE REGISTERED OFFICE IS AT **278, JEEVAN UDYOG BUILDING, 3RD FLOOR, D. N. ROAD, FORT MUMBAI 400001** DO HEREBY UNDERTAKE TO PAY TO THE REGIONAL CONTROLLER OF MINES, INDIAN BUREAU OF MINES GOA REGION-GOA OR ANY OTHER OFFICER AUTHORITY NOMINATED BY THE CONTROLLER GENERAL, INDIAN BUREAU OF MINES AN AMOUNT NOT EXCEEDING **RS.1,27,17,000/- (RS. ONE CRORE TWENTY-SEVEN LAKH SEVENTEEN THOUSAND ONLY)** AGAINST ANY LOSS OR DAMAGE CAUSED TO OR SUFFERED OR WOULD BE CAUSED TO OR SUFFERED BY THE GOVERNMENT OR TOWARDS NONCOMPLIANCE OF PROVISIONS OF RULE 22, 23, 24 AND 26 OF MCDR 2017 I.E. MINE CLOSURE PLAN/ PROGRESSIVE MINE CLOSURE PLAN APPROVED IN RESPECT OF THE MINING LEASE ROWALE BAUXITE MINES FOR BAUXITE (ORE/ORES) OVER AN AREA OF 218.285 HECTARES GRANTED BY STATE GOVERNMENT TO **M/S ASHAPURA MINECHEM LTD, JEEVAN UDYOG BUILDING, 3RD FLOOR, 278, D.N. ROAD, FORT, MUMBAI 400001 (MAHARASHTRA**) SITUATED IN VILLAGE ROWALE, TALUKA DAPOLI, DISTRICT RATNAGIRI MAHARASHTRA STATE BY REASON OF ANY BREACH OF THE SAID LESSEE OF ANY OF THE TERMS OR CONDITIONS CONTAINED IN THE MINE CLOSURE PLAN/ PROGRESSIVE MINE CLOSURE PLAN.

3. WE, BANK DO HEREBY UNDERTAKE TO PAY THE AMOUNT DUE AND PAYABLE UNDER THIS GUARANTEE WITHOUT ANY DEMUR, TO THE AUTHORITY MERELY ON A DEMAND FROM THE REGIONAL CONTROLLER OF MINES, INDIAN BUREAU OF MINES GOA REGION-GOA OR ANY OTHER AUTHORIZED BY THE CONTROLLER GENERAL, INDIAN BUREAU OF MINES STATING THAT THE AMOUNT CLAIMED IS DUE BY WAY OF LOSS OR LOSS OF DAMAGE CAUSED TO OR WOULD BE CAUSED TO OR SUFFERED BY THE GOVERNMENT BY REASON OF BREACH BY THE SAID LESSEE OR ANY OF THE TERMS OR CONDITIONS CONTAINED IN THE MINING PLAN/ REVIEW OF MINING PLAN OR BY REASON OF LESSEE'S FAILURE TO PERFORM THE SAID MINE CLOSURE PLAN/ PROGRESSIVE MINE CLOSURE PLAN. HOWEVER, OUR LIABILITY UNDER THIS GUARANTEE SHALL BE RESTRICTED TO AN AMOUNT NOT EXCEEDING **RS.1,27,17,000/- (RS. ONE CRORE TWENTY-SEVEN LAKH SEVENTEEN THOUSAND ONLY)**

4. WE UNDERTAKE TO PAY TO THE AUTHORITY ON A DEMAND FROM THE REGIONAL CONTROLLER OF MINES, INDIAN BUREAU OF MINES MARGOA-GOA OR ANY OTHER OFFICER AUTHORIZED BY THE CONTROLLER GENERAL, INDIAN BUREAU OF MINES OR GOVT. OF INDIA ANY MONEY SO DEMANDED NOTWITHSTANDING ANY DISPUTE OR DISPUTES RAISED BY THE LESSEE IN ANY SUIT OR PROCEEDINGS PENDING BEFORE ANY COURT OR TRIBUNAL RELATING THERETO OUR LIABILITY UNDER THIS PRESENT IS ABSOLUTE AND UNEQUIVOCAL.
THE PAYMENT SO MADE BY US UNDER THIS BOND SHALL BE VALID DISCHARGE OF OUR LIABILITY FOR PAYMENT THERE UNDER AND LESSEE SHALL HAVE NO CLAIM AGAINST US FOR MAKING SUCH PAYMENT.

BG- 0381IGF000449723, AMT- 1,27,17,000/-, Issue DT-13/02/23
EXPIRY DT - 31/03/2025, CLAIM DT - 30/09/2025

FOR BANK OF BARODA

SENIOR MANAGER
(CREDIT)

BANK OF BARODA ADVANCES GTEE MMO. MUMBAI

5. WE, BANK FURTHER AGREE THAT THE GUARANTEE HEREIN CONTAINED SHALL REMAIN IN FULL FORCE AND EFFECT DURING THE PERIOD UP TO THE END OF THE MINING PLAN / REVIEW OF MINING PLAN PERIOD OF FIVE YEARS THAT WOULD BE TAKEN FOR PERFORMANCE OF THE SAID AGREEMENT AND THAT SHALL CONTINUE TO BE ENFORCEABLE TILL ALL THE DUES OF THE GOVT. UNDER OR BY VIRTUE OF THE SAID AGREEMENT HAVE BEEN FULLY PAID AND ITS CLAIMS SATISFIED OR DISCHARGED TILL REGIONAL CONTROLLER OF MINES, INDIAN BUREAU OF MINES, MARGOA GOA OR ANY OTHER OFFICER AUTHORIZED BY THE CONTROLLER GENERAL, INDIAN BUREAU OF MINES CERTIFIES THAT THE TERMS AND CONDITIONS OF THE SAID PROGRESSIVE MINE CLOSURE PLAN/ FINAL MINE CLOSURE PLAN HAVE BEEN FULLY AND PROPERLY CARRIED OUT BY THE SAID LESSEE AND ACCORDINGLY DISCHARGE THIS GUARANTEE. UNLESS A DEMAND OR CLAIM UNDER THIS GUARANTEE IS MADE ON US IN WRITING ON OR BEFORE 30.09.2025 WE SHALL BE DISCHARGED FROM ALL LIABILITY UNDER THIS GUARANTEE THEREAFTER.

6. WE BANK, FURTHER AGREE THAT REGIONAL CONTROLLER OF MINES, INDIAN BUREAU OF MINES, GOA REGION-GOA OR ANY OTHER OFFICER AUTHORIZED BY THE CONTROLLER GENERAL, INDIAN BUREAU OF MINES SHALL HAVE FULLEST LIBERTY WITHOUT OUR CONSENT AND WITHOUT AFFECTING IN ANY MANNER OUR OBLIGATIONS HEREUNDER TO VARY ANY OF THE TERMS AND CONDITIONS OF THE SAID AGREEMENT OR TO EXTEND TIME OF PERFORMANCE BY THE SAID LESSEE FROM TIME TO TIME OR TO POSTPONE FOR ANY TIME OR FROM TIME TO TIME ANY POWERS EXERCISABLE BY REGIONAL CONTROLLER OF MINES, GOA REGION-GOA AGAINST THE SAID LESSEE AND TO FORBEAR OR ENFORCE ANY OF THE TERMS AND CONDITIONS RELATING TO THE SAID AGREEMENT, WE, (BANK) SHALL NOT BE RELIEVED FROM OUR LIABILITY BY REASON OF ANY SUCH VARIATION OR EXTENSION BEING GRANTED TO THE SAID LESSEE OR FOR ANY FORBEARANCE, ACT OR OMISSION ON THE PART OF REGIONAL CONTROLLER OF MINES, INDIAN BUREAU OF MINES, MARGAO-GOA OR ANY INDULGENCE BY REGIONAL CONTROLLER OF MINES, INDIAN BUREAU OF MINES, MARGAO-GOA TO THE SAID LESSEE OR ANY MANNER OR THING WHATSOEVER WHICH UNDER THE LAW RELATING TO SURETIES, WOULD BUT THIS PROVISION HAVE EFFECT OF SO RELIEVING US.

7. THIS GUARANTEE WILL NOT BE DISCHARGED DUE TO CHANGE IN CONSTITUTION OF THE BANK OR LESSEE.

8. WE, **BANK OF BARODA** LASTLY UNDERTAKE NOT TO REVOKE THIS GUARANTEE DURING ITS CURRENCY EXCEPT WITH THE PREVIOUS CONSENT OF THE REGIONAL CONTROLLER OF MINES, INDIAN BUREAU OF MINES, MARGAO GOA IN WRITING.

9. NOTWITHSTANDING ANYTHING TO THE CONTRARY CONTAINED HEREIN ABOVE

A) OUR LIABILITY UNDER THIS BANK GUARANTEE SHALL NOT EXCEED **RS.1,27,17,000/- (RS. ONE CRORE TWENTY-SEVEN LAKH SEVENTEEN THOUSAND ONLY)**

B) THE BANK GUARANTEE SHALL BE VALID UP TO **31/03/2025.** AND THE PERIOD OF BANK GUARANTEE SUBMITTED IS VALID FOR THE PERIOD OF THE PROPOSALS GIVEN IN MODIFIED MINING PLAN / REVIEW OF MINING PLAN / PMCP ETC. WE ARE LIABLE TO PAY THE GUARANTEE AMOUNT OR ANY PART THEREOF UNDER THIS BANK GUARANTEE AND ONLY AND ONLY IF YOU SERVED UPON US A WRITTEN CLAIM OR DEMAND ON OUR BEFORE **30/09/2025.**

NOTWITHSTANDING ANYTHING TO THE CONTRARY CONTAINED HEREIN ABOVE

(1) OUR LIABILITY UNDER THIS BANK GUARANTEE SHALL NOT EXCEED **1,27,17,000/- (RUPEES ONE CRORE TWENTY SEVEN THOUSAND SEVENTEEN THOUSAND ONLY**

(2) THIS BANK GUARANTEE SHALL BE VALID UPTO **31/03/2025** AND,

(3) WE ARE LIABLE TO PAY THE GUARANTEE AMOUNT OR ANY PART THEREOF UNDER THIS BANK GUARANTEE ONLY AND ONLY IF YOU SERVE UPON US A WRITTEN CLAIM OR DEMAND ON OR BEFORE **(30/09/2025).**

BG - 0381IGF00044 9723, AMT- 1,27,17,000/-, Issue DT 13/02/23
EXPIRY DT - 31/03/2025, CLAIM DT - 30/09/2025

BANK OF BARODA ADVANCES GTEE MMO, MUMBAI

FOR BANK OF BARODA

SENIOR MANAGER
(CREDIT)

THIS GUARANTEE WILL BE OPERATIVE WHEN ACCOMPANIED WITH ADVICE (SFMS) ISSUED FROM THE ADVISING BANK.

10. IF THE BANK GUARANTEE IS TO BE EN-CASHED THROUGH THE COURT, IN THAT CASE THE MARGOA GOA (CITY WHERE INDIAN BUREAU OF MINES, GOA REGIONAL OFFICE IS SITUATED) COURT WILL HAVE JURISDICTION.

11 .IN WITNESS WHEREOF, THE BANK THROUGH ITS AUTHORIZED OFFICER HAS SET ITS HAND AND STAMP ON THIS DAY OF **13/02/2023** AT BANK OF BARODA

BG-0381IGF0004497 23, AMT- 1,27,17,000/-, Issue DT-13/02/23
EXPIRY DT -31/03/2025, CLAIM DT -30/09/2025

BANK OF BARODA ADVANCES GLEE MMO, MUMBAI

FOR BANK OF BARODA

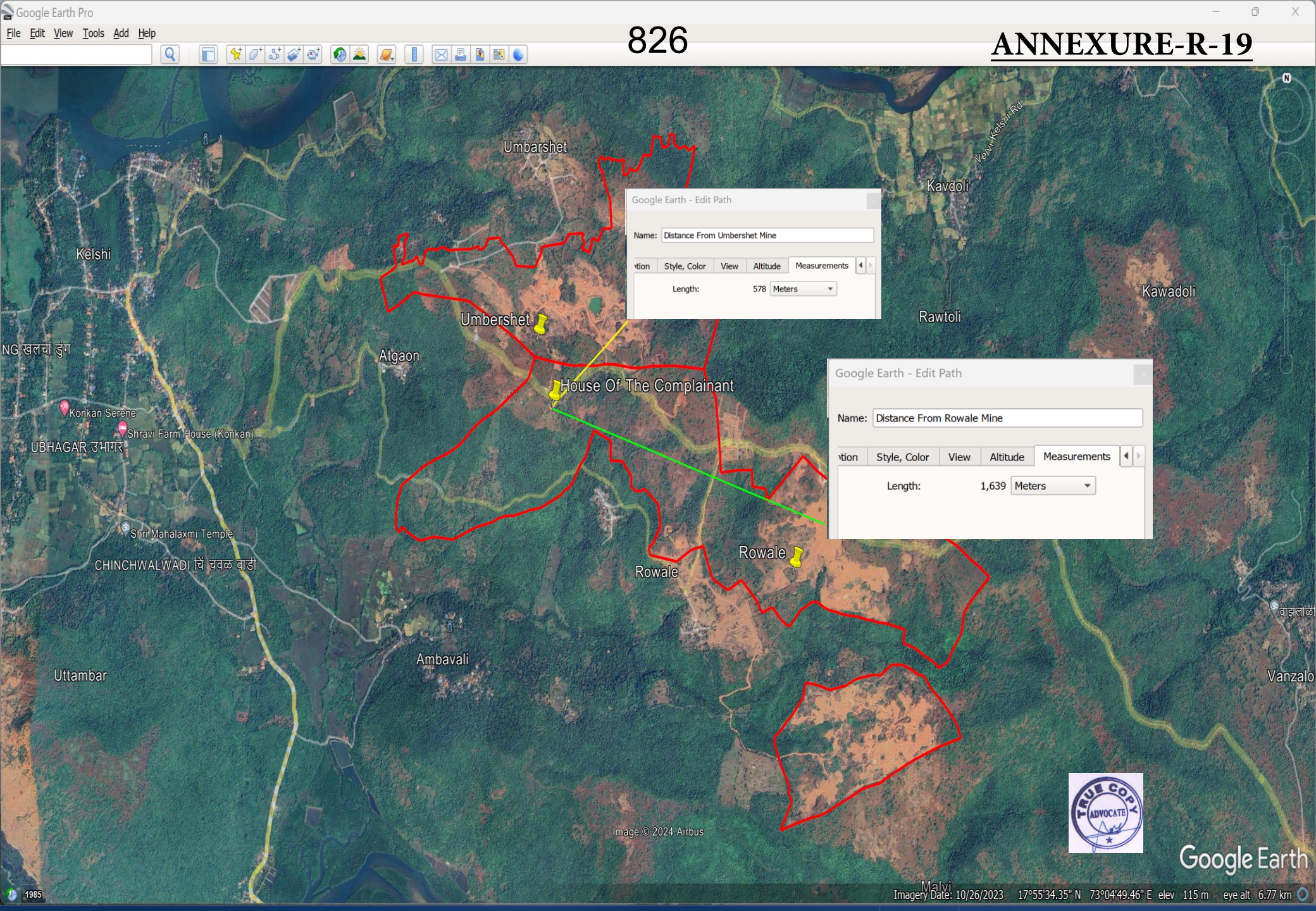
SENIOR MANAGER
(CREDIT)

कृते बैंक ऑफ बड़ौदा
For BANK OF BARODA

सहा. महाप्रबंधक/Asstt. Gen. Manager
मुंबई मुख्य कार्यालय/Mumbai Main Office

TRUE COPY
ADVOCATE

ANNEXURE-R-19



TRUE COPY ADVOCATE